ENCYCLOPÆDIA BRITANNICA.

Liege.

LIEGE, a biſhopric of Germany, in the circle of Weſtphalia; bounded to the north by Brabant, to the ſouth by Champagne and Luxemburg, to the eaſt by Limburg and Juliers, and to the weſt by Brabant, Namur, and Hainault. It is very unequal both in length and breadth; the former being in ſome places above 90 miles, in others not half ſo much; and the latter in ſome places 45, in others hardly 25. The air here is very temperate; and the ſoil fruitful in corn, wine, wood, and paſture. Here alſo are mines of lead and iron, pits of coal, quarries of marble and ſtone, and ſome celebrated mineral waters, as thoſe of Spa and Chau-fontaine. The principal rivers are, the Maes and Sambre. The manufactures and commodities of the country are chiefly beer, arms, nails, ſerge, leather, with the products we have juſt mentioned. The ſtates of the biſhopric are compoſed of three bodies: the firſt is the chapter of Liege; the ſecond, the nobility of the country; and the third, the deputies of the capital and the other towns. The three eſtates are ſeldom called together, except to raiſe taxes for the ſervice of the province, or upon ſome particular emergency; but there is a committee of the ſtates, who meet thrice a-week, and in time of war daily. They are always about the prince-biſhop, to make remonſtrances, and demand the redreſs of grievances. The biſhop is ſpiritual and temporal lord of the whole country; but, as biſhop, is ſuffragan to the archbiſhop of Cologne. He ſtyles himſelf, *by the grace of God, biſhop and prince of Liege, duke of Bouillon, marquis of Franchimont, count of Looz, Hoorn*, &c. His arms for Liege are, a pillar argent, on a pedeſtal of the ſame, with a crown or, in a field ruby. In the matricula he was formerly rated at 50 horſe and 170 foot; or 1280 florins monthly, in lieu of them, but now only at 826. An abatement of one-third has alſo been granted of the ancient aſſeſſment to the chamber-court, which was 360 rix-dollars 62$\frac{1}{2}$ kruitzers for each term. Here are ſeveral colleges which ſit at Liege, for the government of the country, and the deciſion of cauſes, civil, criminal, ſpiritual, and feudal, and of ſuch alſo as relate to the finances. The chapter conſiſts of 60 perſons, who muſt either prove their nobility for four generations, both by father and mother, before they can be admitted: or if they cannot do that, muſt at leaſt have been doctors or licentiates of divinity for ſeven years, or, of law, for five years, in ſome famous univerſity. The biſhopric is very populous and extenſive, containing 1500 pariſhes, in which are 24 walled towns, beſides others, 52 baronies, beſides counties and ſeigniories, 17 abbeys for men, who muſt be all gentlemen, and 11 for ladies, excluſive of others.

LIEGE, the capital of the biſhopric of the ſame name, ſtands upon the Maes, in a fine valley, ſurrounded with woods and hills, being a free imperial city, and one of the largeſt and moſt eminent in Europe. Though it is 100 miles from the ſea by water, the Maes is navigable up to it. The city has 16 gates; 17 bridges, ſome of them very handſome; 154 ſtreets, many of them ſtraight and broad; a fine epiſcopal palace; a very large ſtately cathedral, in which, beſides five great ſilver coffers full of relics, are ſeveral ſilver ſtatues of ſaints, and a St George on horſeback of maſſy gold, preſented to the cathedral by Charles the Bold, by way of atonement for uſing the inhabitants cruelly in the year 1468. Of the other churches, that of St Paul is the moſt remarkable, both for its ſtructure and fine ornaments in painting and marble. The city is well fortified, and there are alſo two caſtles on the mountain of the Holy Walburg for its defence. Beſides a great number of other convents of both ſexes, here is a college of Engliſh Jeſuits, founded in the year 1616, and a fine nunnery of Engliſh ladies. Indeed, churches, convents, and other religious foundations, take up the greater part of it. The reader, therefore, no doubt, will take it for granted, that it is a moſt bleſſed, holy, and happy city. But however it may fare with the profane, unhallowed laity, it is certainly the paradiſe of prieſts, as it is expreſsly called, by way of eminence. It is divided into the old and new, or the upper and lower; and the latter again into the iſland, and the quarter beyond the Maes. The houſes are high, and built of bluiſh marble. In the town and ſuburbs are 12 public places or ſquares, 10 hoſpitals, a beguin-houſe, and two fine quays, planted with ſeveral rows of trees, for the burghers to take the air; but a great part of that within the walls is taken up with orchards and vineyards. The manufactures of this city are arms, nails, leather, ſerge, and beer. In St William's convent, without the city, is the tomb of the famous Engliſh traveller Sir John Mandeville, with an inſcription in barbarous French, requeſting thoſe who read it to pray for his ſoul. Near it are kept the ſaddle, ſpurs, and knife, that he made uſe of in his travels.

Liege.

After having feen moft of the cities of any note in the world, he made choice of this to fpend the eve of his life in. A little way from the city, on the other fide of the Maes, ftands the epifcopal palace of Seraing, in which the bifhops generally refide during the fummer. The latitude of this city is 50.36. N. and the longitude 5.40. E.

Some difturbances took place here in the year 1789, in confequence of certain difputes that had arifen between the prince-bifhop and the inhabitants. The latter having demanded certain privileges, which he did not think proper to grant, they took up arms, and compelled him and his chapter to comply with their requeft. The prince, together with many of the clergy, nobility, and citizens, alarmed by this commotion, and dreading the confequences of popular fury, which when once roufed feldom knows any bounds, fought fafety by a voluntary exile. They then appealed to the imperial chamber; and this tribunal, inftead of acting the part of arbiter, decided as a fovereign, and ordered the circles of the Lower Rhine and Weftphalia to execute the fentence.

The king of Pruffia, at whofe court one of the chiefs of the infurrection had refided, and who wifhed to gain a party at Liege, became mediator; and feemed to favour the Liegoife, many of whofe claims were juft, though they attempted to enforce them by violence and the moft illegal fteps. Intoxicated with this protection, the people of Liege treated the remonftrances of their bifhop, the decrees of the imperial chamber, and the refolutions of the directory of the two circles, with the utmoft contempt; and proceeded fo far as even to dethrone their prince, by appointing a regent in the perfon of a French prelate. The electoral college having deliberated on the beft means of putting an end to thefe difturbances, its propofitions, though modified by M. Dohm the Pruffian plenipotentiary, made the infurgents break out into open fedition. Deluded by their leaders, they gave themfelves up every day to new exceffes; the effects of the citizens were expofed to pillage, and their perfons to infult. The king of Pruffia, who was defirous to bring matters to an accommodation, and not to inftigate the Liegoife to become independent, finding that the efforts of his minifter were not attended with the defired fuccefs, feemed unwilling to interfere any farther in an affair which might have led him into a quarrel with the empire. The executive troops, at the fame time, remained almoft in a ftate of inactivity; and feemed rather to guard the frontiers of this petty ftate, than to make any attempt to reduce it to obedience. Neither this conduct, however, nor the exhortations of Pruffia, added to the moral certainty of their being foon compelled to lay down their arms, made any change in the conduct of the malecontents. They declared openly, in the face of all Europe, that they would either conquer or die; and they perfifted in this refolution, while commerce, manufactures, and the public revenues, were going daily to decay.

Having at length openly attacked the executive forces without the territories of their city, the emperor could no longer remain an indifferent fpectator. It was now full time to put a period to that madnefs to which the people had abandoned themfelves; and to accomplifh this in an effectual manner, the imperial chamber at Wetzlar requefted the emperor, as a member of the ancient circle of Burgundy, to execute its orders refpecting this object. In confequence of this meafure, Baron Alvinzi, who commanded a body of Auftrians cantoned in Limburg and the confines of Brabant, notified, by order of Marfhal Bender, to the ftates and municipality of Liege, that the emperor intended to fend troops into their city and territories, for the purpofe of reftoring tranquillity and good order. The ftates had already been informed of this refolution by their agent at Wetzlar. They therefore wrote to Marfhal Bender, to affure him of the refpectful confidence which they placed in the juftice and magnanimity of the emperor, and to requeft that the Auftrian troops might enter alone, without thofe of the electors; and that they might be confined to occupy the gates and the fuburbs only. To this letter, which was carried to Bruffels by a deputation of the ftates, Marfhal Bender returned a very fatisfactory anfwer, relating to the difpofition of the electoral troops: but Baron Alvinzi, in a note which he wrote to the ftates, infifted among other articles, that all the citizens fhould throw down their arms; that proper accommodations fhould be prepared for the officers and men; that the warlike ftores, collected for making refiftance, fhould be removed; and that cockades, and every other diftinctive mark of the like kind, fhould be laid afide before the arrival of the imperial troops. However humiliating thefe preliminaries might be, efpecially that of a general difarming, the ftates and municipalities acquiefced without the leaft referve; and their fubmiffion, as fudden as complete, was communicated to the people, with an exhortation to follow their example.

Notwithftanding this pacific appearance, two days before the entrance of the imperial troops, the municipal council of Liege, flattering themfelves, perhaps, with the hopes of affiftance from Pruffia, affured the inhabitants that they would remain unfhaken in their poft, and that they had fworn never to defert the caufe in which they were engaged. This, however, did not prevent the Auftrian troops, to the number of 6000, from penetrating, without oppofition, into the heart of the city; where they occupied every poft; made the citizens lay afide their arms, uniforms, and cockades; and in a fingle hour, dethroned fo many fovereigns of a year. The greater part of the municipal officers, who two days before had folemnly promifed fuch great things, betook themfelves to flight, and retired either to France or Wefel; while the ancient magiftracy, which had been expelled in the month of Auguft 1789, was provifionally reinftated by the directorial commiffioners.—The decrees of the imperial chamber at Wetzlar have fince been executed in their utmoft extent. The ancient magiftracy and the privy council of the prince-bifhop have been reftored; and the prince himfelf having returned, peace and good order have been re-eftablifhed. The French took this city in 1792, and effected another revolution; but being driven from it in 1793, the citizens were once more obliged to fubmit.

Liege, Lientery.

LIENTERY, a flux of the belly, in which the aliments are difcharged as they are fwallowed, or very little altered either in colour or fubftance. See MEDICINE *Index*.

LIEVENS,

Lievens, Lieou-Kieou.

LIEVENS, JOHN or JAN, a celebrated painter, was born at Leyden in 1607. He discovered an early inclination for the arts, and was the disciple first of Joris van Schooten, and afterwards of Peter Lastman. He excelled principally in painting portraits; but he also executed several historical subjects with great success. He came over to England, where he resided three years, and painted the portraits of Charles I. the queen, the prince of Wales, and several of the nobility; after which he returned to Antwerp, where he met with full employment for his pencil. We have several etchings by this master, which are performed in a slight, but masterly manner. The chiaro scuro is very skilfully managed in them, so as to produce a most powerful effect. His style of etching bears some resemblance to that of Rembrandt; but it is coarser in general, and less finished.

LIEOU-KIEOU, the name of certain islands of Asia, subject to China; but hitherto little known to geographers, who have been satisfied with marking their existence and latitude in their charts. They, however, form a powerful and extensive empire, the inhabitants of which are civilized, and ought not to be confounded with other savage nations dispersed throughout the islands of Asia. Father Gabil, a Jesuit, has furnished us with some interesting details respecting these islanders, which he extracted from a Chinese relation, published in 1721, at the end of a voyage that was undertaken on the following account. The emperor Kang-hi having resolved in 1719, to send an ambassador to the king of Lieou-kieou, chose for this purpose one of the great doctors of the empire, named *Supao-Koang*. This learned man departed from China in 1719, and returned to Peking in 1720, where, in the year following, he caused a relation of his voyage to be published in two volumes. It is in the first of these that he gives an accurate and particular description of the isles of Lieou-Kieou; and what he relates appears to be worthy of the greater credit, because, being on the spot, he examined, as he himself says, according to the orders of the emperor, whatever he found curious or interesting, respecting the number, situation, and productions of these isles; as also the history, religion, manners, and customs of the people who inhabit them.

These isles, situated between Corea, Formosa, and Japan, are in number 36. The principal and largest is called *Lieou-Kieou;* the rest have each a particular denomination. The largest island extends from north to south almost 440 lys, and 120 or 130 from east to west; but on the south side, the extent from east to west is not 100 lys. The south-east part of the island, where the court resides, is called *Cheou-li;* and it is there that Kint-ching, the capital city, is situated. The king's palace, which is reckoned to be four leagues in circumference, is built on a neighbouring mountain. It has four gates, which correspond to the four cardinal points; and that which fronts the west forms the grand entry. The view which this palace commands is most extensive and delightful; it reaches as far as the port of Napa-kiang, at the distance of ten lys, to the city of Kint-ching, and to a great number of other cities, towns, villages, palaces, temples, monasteries, gardens, pleasure houses. It stands in longitude 146° 26′ east, and in latitude 26° 2′ north.

Lieou-Kieou.

If we believe these islanders, the origin of their empire is lost in the remotest antiquity. They reckon up 25 successive dynasties, the duration of which forms a period of more than 18,000 years. It would be useless to employ a single moment in pointing out the absurdity of these pretensions. It is, however, certain, that the existence of the country called *Lieou-kieou* was not known in China before the year 605 of the Christian era. It was in the course of that year, that one of the emperors of the dynasty of Soui, having heard of these isles, was desirous of knowing their situation. This prince at first sent some Chinese thither; but their expedition proved fruitless, as the want of interpreters prevented them from acquiring that knowledge which was the object of their voyage. They only brought some of the islanders with them to Sigan-fou, the capital of the province of Chen-si, which was the usual residence of the emperors of the dynasty of Soui. It fortunately happened, that an ambassador of the king of Japan was then at court. This ambassador and his attendants immediately knew the strangers to be natives of Lieou-kieou: but they spoke of these isles as of a miserable and wretched country, the inhabitants of which had never been civilized. The emperor of China afterwards learned, that the principal island lay to the east of a city called at present *Foutcheou-fou*, which is the capital of the province of Fo-kien; and that, in a passage of five days, one might reach the large island where the king kept his court.

On this information, the emperor Yang-ti sent skilful men, accompanied by interpreters, to summon the prince to do homage to the emperor of China, and to pay him tribute. This proposal was very ill received. The king of Lieou-kieou sent back the Chinese, telling them sternly, that he acknowledged no prince to be his superior. This answer irritated the emperor, who, to obtain revenge, caused a fleet to be immediately equipped in Fo-kien, in which he embarked 10,000 men. This fleet set sail, and arrived in safety at the port of Napa-kiang. The army, in spite of every effort made by the natives, landed on the island; and the king, who had put himself at the head of his troops to oppose the enemy, having fallen in battle, the Chinese pillaged, sacked, and burnt the royal city, made more than 5000 slaves, and returned to China.

The emperors of the dynasty of Tang, those of the short dynasties that followed, and those of the dynasty of Song, although they were fully informed of every thing respecting the Lieou-kieou isles, made no attempts to render them tributary. In 1291, Chi-tsou, emperor of the dynasty of Yven, was desirous of reviving the pretensions of his predecessors. He fitted out a fleet to subdue these islands; but schemes of conquest had become disagreeable to the Chinese, since the disaster that befel their army in an expedition against Japan. The fleet of Chi-tsou went no farther than the isles of Pong-hou, and the western coast of Formosa, from whence, under divers pretences, they returned to the ports of Fo-kien.

It was only in 1372, under the reign of Hong-vou, founder of the dynasty of Ming, that these islands submitted voluntarily to the Chinese government. Hong-vou had sent one of the grandees of his court to Tsaytou, who was then reigning at Lieou-kieou, to inform him

Lieou-Kieou. him of his acceffion to the throne. The Chinefe nobleman had received particular inftructions refpecting this commiffion, and he acquitted himfelf of it with all the prudence and addrefs of an able minifter. In a private audience which he had with Tfay-tou, he exhorted this prince to declare himfelf a tributary of the empire, and laid before him the advantages he would derive from this ftep. His reafoning, fupported by the power of his natural eloquence, made fo much impreffion on the mind of Tfay-tou, that he embraced the propofal made him, and fent immediately to the emperor to demand the inveftiture of his ftates.

Hong-vou received his envoys in a magnificent manner, and loaded them with prefents. He folemnly declared Tfay-tou a vaffal of the empire; and, after having received his firft tribute (which confifted in valuable horfes, aromatic wood, fulphur, copper, tin, &c. he fent to this prince a golden feal, and confirmed the choice he had made of one of his fons for fucceffor. The emperor afterwards fent 36 families, almoft all from the province of Fo kien to Lieou-kieou. Tfay-tou received them, affigned them lands near the port of Napa-kiang, and appointed certain revenues for their ufe, at the fame time that Hong-vou made them confiderable remittances. Thefe families firft introduced into Lieou-kieou the learned language of the Chinefe, the ufe of their characters, and the ceremonies practifed in China in honour of Confucius. On the other hand, the fons of feveral of the grandees of the court of Tfay-tou were fent to Nan-king, to ftudy Chinefe in the imperial college, where they were treated with diftinction, and maintained at the emperor's expences.

The ifles of Lieou-kieou had neither iron nor porcelain. Hong-vou fupplied this want; he caufed a great number of utenfils of iron and inftruments to be made, which he fent thither, together with a quantity of porcelain veffels. Commerce, navigation, and the arts foon began to flourifh. Thefe iflanders learned to caft bells for their temples, to manufacture paper and the fineft ftuffs, and to make porcelain, with which they had been fupplied before from Japan.

The celebrated revolution which placed the Tartars on the imperial throne of China, produced no change in the conduct of the kings of Lieou-kieou. Chang-tché, who was then reigning, fent ambaffadors to acknowledge Chun-tchi, and received a feal from him, on which were engraven fome Tartar characters. It was then fettled, that the king of Lieou-kieou fhould pay his tribute only every two years, and that the number of perfons in the train of his envoys fhould not exceed 150.

The emperor Kang-hi feemed to pay more attention to thefe ifles than any of his predeceffors. He caufed a fuperb palace to be erected in honour of Confucius, and a college where he maintained mafters to teach the fciences and the Chinefe characters. He alfo inftituted examinations for the different degrees of the literati. He ordained, that the king of Lieou-kieou fhould never fend in tribute rofe-wood, cloves, or any other production which was not really of the growth of the country; but that he fhould fend a fixed quantity of fulphur, copper, tin, fhells, and mother of pearl, which is remarkably pretty in thefe iflands. He permitted, that, befides the ufual tribute, he might prefent him horfe-furniture, piftol-cafes, and other things of the fame kind, which thefe iflanders are faid to manufacture with great tafte and neatnefs. Lieou-Kieou.

It is more than 900 years fince the bonzes of China introduced at Lieou-kieou the worfhip of Fo, and the principal books belonging to their fect. This worfhip is at prefent the eftablifhed religion both of the grandees and of the people. There is ftill to be feen in the royal city a magnificent temple, erected in honour of another idol borrowed from the Chinefe, named *Tein-fey*, which fignifies *celeftial queen* or *lady*.

Thefe iflanders do not make promifes or fwear before their idols. When they have occafion to do this, they burn perfumes, prefent fruits, and ftand refpectfully before fome ftone, which they call to witnefs the folemnity of their engagements. Numbers of ftones are to be feen in the courts of their temples, in moft public places, and upon their mountains, which are entirely appropriated to this purpofe. They have alfo among them women confecrated for the worfhip of fpirits, who are fuppofed to have great influence over thefe beings. They vifit the fick, diftribute medicines, and recite prayers for their recovery.

They refpect the dead as much as the Chinefe, and they are no lefs ceremonious in wearing mourning; but their funerals are neither fo pompous, nor attended with fo much expence. Their coffins, which are of an hexagonal or octagonal figure, are three or four feet high. They burn the flefh of the bodies of their dead, and preferve only the bones. They never offer provifions to them; they are contented with placing lamps round them, and burning perfumes.

Different families are diftinguifhed in Lieou-kieou by furnames, as in China; but a man and a woman of the fame furname cannot be united in marriage. The king is not permitted to marry but in the three grand families, which always enjoy the higheft offices. There is a fourth, of equal diftinction to the three former; but neither the king nor the princes contract any alliances with this family; for it is doubtful whether it be not fprung from the fame ftem as the royal line.

A plurality of wives is allowed in thefe ifles. Young men and young women enjoy the liberty of feeing one another, and of converfing together; and their union is always in confequence of their own choice. The women are very referved; they never ufe paint, and wear no pendants in their ears; they collect their hair on the top of their heads in the form of a curl, and fix it in that manner by means of long pins made of gold or filver.

Befides the vaft domains which the king poffeffes, he receives the produce of all the fulphur, copper, and tin mines, and of the falt pits, together with what arifes from taxes. From thefe revenues he pays the falaries of the mandarins and officers of his court. Thefe falaries are eftimated at a certain number of facks of rice; but under this name is comprehended whatever the king gives in grain, rice, filk, cloth, &c. The whole is valued according to the price of the facks of rice.

There are here, as in China, nine orders of mandarins, who are diftinguifhed by the colour of their caps, or by their girdles and cufhions. The greater part of the titles of thefe mandarins are hereditary in their families; but there are fome which are only beftowed upon merit. In the royal city there are tribunals eftablifhed

blifhed for managing the revenue and affairs of the principal ifland, and of all the others which are dependent on it. The latter have agents, who refide at court. There are alfo particular tribunals for civil and criminal matters; for whatever concerns the families of the grandees and princes; for the affairs of religion; for infpecting the public granaries, king's revenues, duties; for commerce, manufactures, civil ceremonies, and for navigation, public edifices, literature, and war.

The veffels that are built in this country are greatly valued by the people of China and Japan. In thefe the natives go not only from one ifland to another, but alfo to China, Tong-king, Cochin-China, Corea, Nangaza-ki, Satfuma, the neighbouring ifles, and to Formofa, where they difpofe of their different commodities. Befides thofe articles of commerce which their manufactures of filk, cotton, paper, arms, copper utenfils, &c. furnifh them, they alfo export mother-of-pearl, tortoife and other fhells, coral and whetftones, which are in great requeft both in China and Japan.

LIEUTAUD, Dr Joseph, counfellor of ftate and firft phyfician at the court of France, was born at Aix in Provence, and refided principally there till he took the degree of doctor of medicine. After this he profecuted his ftudies for fome years at Montpelier. He returned to Aix, where he foon acquired extenfive practice, and became eminent for literary abilities. He refided there till the year 1750, when he was invited to act as phyfician to the royal infirmary at Verfailles. There he practifed with fuch reputation and fuccefs, that he foon arrived at the head of his profeffion; and in the year 1774, upon the death of M. Senac, he was appointed archiater. His extenfive engagements in practice did not prevent him from cultivating the fcience of medicine in all its branches, and from freely communicating to others the refult of his own ftudies. He publifhed many valuable works; amongft which the following may be accounted the moft remarkable. 1. *Elementa Phyfiologiæ*. 2. *Precis de la Medicine*. 3. *Pratique Precis de la Matiere Medicale*. 4. *Effais Anatomiques*. 5. *Synopfis Univerfæ Praxeos Medicinæ*. 6. *Hiftoria Anatomico-Medica*. He died at Verfailles in 1780, aged 78 years.

LIEUTENANT, an officer who fupplies the place and difcharges the office of a fuperior in his abfence. Of thefe, fome are civil, as the lords-lieutenants of kingdoms, and the lords-lieutenants of counties; and others are military, as the lieutenant-general, lieutenant-colonel, &c.

Lord-Lieutenant of Ireland, is properly a viceroy; and has all the ftate and grandeur of a king of England, except being ferved upon the knee. He has the power of making war and peace, of beftowing all the offices under the government, of dubbing knights, and of pardoning all crimes except high treafon; he alfo calls and prorogues the parliament, but no bill can pafs without the royal affent. He is affifted in his government by a privy council; and, on his leaving the kingdom, he appoints the lords of the regency, who govern in his abfence.

Lords-Lieutenants of Counties, are officers, who upon any invafion or rebellion, have power to raife the militia, and to give commiffions to colonels and other officers, to arm and form them into regiments, troops, and companies. Under the lords-lieutenants, are deputy-lieutenants, who have the fame power; thefe are chofen by the lords-lieutenants, out of the principal gentlemen of each county, and prefented to the king for his approbation.

Lieutenant-Colonel. See Colonel.

Lieutenant-General. See General.

Lieutenant, in the land fervice, is the fecond commiffioned officer in every company of both foot and horfe, and next to the captain, and who takes the command upon the death or abfence of the captain.

Lieutenant of Artillery. Each company of artillery hath four; 1 firft and 3 fecond lieutenants. The firft lieutenant hath the fame detail of duty with the captain, becaufe in his abfence he commands the company: he is to fee that the foldiers are clean and neat; that their clothes, arms, and accoutrements, are in good and ferviceable order; and to watch over every thing elfe which may contribute to their health. He muft give attention to their being taught the exercife, fee them punctually paid, their meffes regularly kept, and to vifit them in the hofpitals when fick. He muft affift at all parades, &c. He ought to underftand the doctrine of projectiles and the fcience of artillery, with the various effects of gunpowder, however managed or directed; to enable him to conftruct and difpofe his batteries to the beft advantage; to plant his cannon, mortars, and howitzers, fo as to produce the greateft annoyance to an enemy. He is to be well fkilled in the attack and defence of fortified places; and to be converfant in arithmetic, mathematics, mechanics, &c.

Second Lieutenant in the Artillery, is the fame as an enfign in an infantry regiment, being the youngeft commiffioned officer in the company, and muft affift the firft lieutenant in the detail of the company's duty. His other qualifications fhould be equal with thofe of the firft lieutenant.

Lieutenant of a Ship of War, the officer next in rank and power to the captain, in whofe abfence he is accordingly charged with the command of the fhip, as alfo the execution of whatever orders he may have received from the commander relating to the king's fervice.

The lieutenant who commands the watch at fea, keeps a lift of all the officers and men thereto belonging, in order to mufter them when he judges it expedient, and report to the captain the names of thofe who are abfent from their duty. During the night watch, he occafionally vifits the lower decks, or fends thither a careful officer, to fee that the proper centinels are at their duty, and that there is no diforder amongft the men; no tobacco fmoked between decks, nor any fire or candles burning there, except the lights which are in lanthorns, under the care of a proper watch, on particular occafions. He is expected to be always upon deck in his watch, as well to give the neceffary orders with regard to trimming the fails and fuperintending the navigation, as to prevent any noife or confufion; but he is never to change the fhip's courfe without the captain's directions, unlefs to avoid an immediate danger.

The lieutenant, in time of battle, is particularly to fee that all the men are prefent at their quarters where they have been previoufly ftationed according to the regulations made by the captain. He orders and exhorts them everywhere to perform their duty, and acquaints the captain at all other times of the misbehaviour of any perſon in the ſhip, and of whatever elſe concerns the ſervice or diſcipline.

The youngeſt lieutenant in the ſhip, who is alſo ſtyled *lieutenant at arms*, beſides his common duty, is particularly ordered, by his inſtructions, to train the ſeamen to the uſe of ſmall arms, and frequently to exerciſe and diſcipline them therein. Accordingly his office, in time of battle, is chiefly to direct and attend them; and at all other times to have a due regard to the preſervation of the ſmall arms, that they be not loſt or embezzled, and that they are kept clean and in good condition for ſervice.

Lieutenant-Reformed, he whoſe company or troop is broke or diſbanded, but continued in whole or half pay, and ſtill preſerves his right of ſeniority and rank in the army.

LIFE, is peculiarly uſed to denote the animated ſtate of living creatures, or the time that the union of their ſoul and body laſts.

The Prolongation of Life is made by Lord Bacon one of the three branches of medicine; the other two relating to the preſervation of health, and the cure of diſeaſes. See Medicine.

The theory of prolonging life he numbers among the deſiderata. Some means or indications that ſeem to lead to it, he lays down as follow:

Things are preſerved in two manners; either in their *identity*, or by *reparation.* In their *identity;* as a fly or ant in amber; a flower, or fruit, or wood, in a conſervatory of ſnow; a dead carcaſe in balſams. By *reparation;* as a flame, or a mechanical engine, &c. To attain to the prolongation of life, both theſe methods muſt be uſed. And hence, according to him, ariſe three intentions for the prolongation of life; *Retardation* of conſumption, proper *reparation*, and *renovation* of what begins to grow old.

Conſumption is occaſioned by two kinds of depredation; a depredation of the innate ſpirit, and a depredation of the ambient air. Theſe may be each prevented two ways; either by rendering thoſe agents leſs predatory, or by rendering the paſſive parts (viz. the juices of the body), leſs liable to be preyed on. The ſpirit will be rendered leſs predatory, if either its ſubſtance be condenſed, as by the uſe of opiates, grief, &c.; or its quantity diminiſhed, as in ſpare and monaſtic diets; or its motion calmed, as in idleneſs and tranquillity. The ambient air becomes leſs predatory, if it be either leſs heated by the rays of the ſun, as in cold climates, in caves, mountains, and anchorets cells; or be kept off from the body, as by a denſe ſkin, the feathers of birds, and the uſe of oils and unguents without aromatics. The juices of the body are rendered leſs liable to be preyed on, either by making them harder or more moiſt and oily; harder, as by a coarſe ſharp diet, living in the cold, robuſt exerciſes, and ſome mineral baths: moiſter, as by the uſe of ſweet foods, &c. abſtaining from ſalts and acids; and eſpecially by ſuch a mixture of drink as conſiſts wholly of fine ſubtile particles, without any acrimony or acidity.

Reparation is performed by means of aliment; and alimentation is promoted four ways: By the concoction of the viſcera, ſo as to extrude the aliment: By exciting the exterior parts to the attraction of the aliment; as in proper exerciſes and frications, and ſome unctions and baths: By the preparation of the food itſelf, ſo as it may more eaſily inſinuate itſelf, and in ſome meaſure anticipate the digeſtion; as in various ways of dreſſing meats, mixing drinks, fermenting breads, and reducing the virtues of theſe three into one: By promoting the act of aſſimilation itſelf, as in ſeaſonable ſleep, ſome external application, &c.

The *renovation* of what begins to grow old, is performed two ways: By the inteneration of the habit of the body; as in the uſe of emollients, emplaſters, unctions, &c. of ſuch a nature, as do not extract but impreſs: Or by purging off the old juices, and ſubſtituting freſh ones; as in ſeaſonable evacuations, attenuating diets, &c.

The ſame author adds theſe three axioms: That the prolongation of life is to be expected, rather from ſome ſtated diets, than either from any ordinary regimen or any extraordinary medicines; more from operating on the ſpirits, and mollifying the parts, than from the manner of feeding; and this mollifying of the parts without is to be performed by ſubſtantials, impriments, and occludents. See Longevity.

Life-Boat, a moſt important invention, conſiſting in an improvement of the ordinary conſtruction of a boat, by which it cannot be ſunk in the rougheſt ſea; ſo that it is peculiarly fitted for bringing off mariners from wrecks during a ſtorm, and thus ſaving many valuable lives. The life-boat was firſt conceived at South Shields, in the county of Durham. A committee of the inhabitants of that town, who had often been the ſad witneſſes of many melancholy ſhipwrecks in which by the ordinary means no relief could be given, in a public advertiſement requeſted information on this ſubject, with models of boats which would be moſt proper for the purpoſe of ſaving perſons from ſhipwreck. The committee it would appear, employed Mr Greathead, a boat-builder in South Shields, who had with others preſented the model of a boat for this purpoſe, to build the firſt boat, which upon trial was found fully to anſwer the purpoſe. Two claimants have ſince appeared for the honour of the invention, which according to Mr Farles, the chairman of the committee, in his letter to Mr Hails the ſupporter of one claim, belongs to two of the members themſelves, namely Mr Farles himſelf and Mr Rockwood. The claimants above alluded to are Mr Greathead, and a Mr Wouldhave a painter in South Shields, and a very ingenious man, who alſo preſented a model to the committee. The claim of the latter is keenly ſupported by Mr Hails, in a pamphlet publiſhed in 1806, two years after Mr Greathead's pamphlet containing the hiſtory and progreſs of the invention, and of the boats which he had built for the purpoſe, his application to parliament, and the premium of 1200l. which he received for the invention, &c. and four years after this application to parliament. It is true that in 1802, Mr Wouldhave and his friends aſſerted his claim in the Monthly Magazine and in ſome provincial newſpapers; but ſtill this was one year after Mr Greathead's application for reward was made to parliament. But, without being at all underſtood to decide to whom the merit of the invention is due, we ſhall leave it to our readers to examine the evidence for themſelves, and ſhall now proceed to give an account of the conſtruction of the life-boat, of which 31 have been built by Mr

Life-Boat. Mr Greathead, and ſent to different parts of Britain, and the north of Europe. The following conſtruction is according to Mr Greathead's plan:

"The length thirty feet; the breadth ten feet; the depth, from the top of the gunwale to the lower part of the keel in midſhips, three feet four inches; from the gunwale to the platform (within) two feet four inches; from the top of the ſtems (both ends being ſimilar) to the bottom of the keel, five feet nine inches. The keel is a plank of three inches thick, of a proportionate breadth in midſhips, narrowing gradually toward the ends, to the breadth of the ſtems at the bottom, and forming a great convexity downward; the ſtems are ſegments of a circle with conſiderable rakes; the bottom ſection, to the floor heads, is a curve fore and aft with the ſweep of the keel; the floor timber has a ſmall riſe curving from the keel to the floor heads; a bilge plank is wrought in on each ſide next the floor heads, with a double rabbit or groove of a ſimilar thickneſs with the keel, and on the outſide of this are fixed two bilge-trees correſponding nearly with the level of the keel; the ends of the bottom ſection form that fine kind of entrance obſervable in the lower part of the bow of the fiſhing boat called a *coble*, much uſed in the north; from this part to the top of the ſtem, it is more elliptical, forming a conſiderable projection; the ſides from the floor heads to the top of the gunwale, flaunch off on each ſide, in proportion to about half the breadth of the floor; the breadth is continued far forward toward the ends, leaving a ſufficient length of ſtraight ſide at the top; the ſheer is regular along the ſtraight ſide, and more elevated toward the ends; the gunwale fixed on the outſide is three inches thick; the ſides, from the under part of the gunwale along the whole length of the regular ſheer, extending twenty-one feet ſix inches, are caſed with layers of cork, to the depth of 16 inches downward; and the thickneſs of this caſing of cork being four inches, it projects at the top a little without the gunwale; the cork on the outſide is ſecured with thin plates or ſlips of copper, and the boat is faſtened with copper nails; the thwarts (or ſeats) are five in number, double banked, conſequently the boat may be rowed with ten oars; the thwarts are firmly ſtanchioned; the ſide oars are ſhort (A), with iron tholes, and rope grommets, ſo that the rower can pull either way. The boat is ſteered with an oar at each end; and the ſteering oar is one-third longer than the rowing oar; the platform placed at the bottom within the boat, is horizontal the length of the midſhips, and elevated at the ends, for the convenience of the ſteerman, to give him a greater power with the oar. The internal part of the boat next the ſides, from the under part of the thwarts down to the platform, is caſed with cork; the whole quantity of which, affixed to the life-boat, is nearly ſeven hundred weight; the cork indiſputably contributes much to the buoyancy of the boat when full of water, is a good defence when going alongſide a veſſel, and is of principal uſe in keeping the boat in an erect poſition in the ſea, or rather of giving her a very lively and quick diſpoſition to recover from any ſudden cant or lurch which ſhe may receive from the ſtroke of a heavy wave: but, excluſive of the cork, the admirable conſtruction of this boat gives it a decided preeminence. The ends being ſimilar, the boat can be rowed either way, and this peculiarity of form alleviates her in riſing over the waves; the curvature of the keel and bottom facilitates her movement in turning, and contributes to the eaſe of the ſteerage, as a ſingle ſtroke of the ſteering oar has an immediate effect, the boat moving as it were upon a centre; the fine entrance below is of uſe in dividing the waves, when rowing againſt them; and combined with the convexity of the bottom and the elliptical form of the ſtem, admits her to riſe with wonderful buoyancy in a high ſea, and to launch forward with rapidity, without ſhipping any water, when a common boat would be in danger of being filled. The flaunching or ſpreading form of the boat, from the floor heads to the gunwale, gives her a conſiderable bearing; and the continuation of the breadth well forward, is a great ſupport to her in the ſea; and it has been found by experience that boats of this conſtruction are the beſt ſea boats for rowing againſt the turbulent waves. The internal ſhallowneſs of the boat from the gunwale down to the platform, the convexity of the form, and the bulk of cork within, leave a very diminiſhed ſpace for the water to occupy; ſo that the life boat, when filled with water, contains a conſiderably leſs quantity than the common boat, and is in no danger either of ſinking or overturning.

It may be preſumed by ſome, that in caſes of high wind, agitated ſea, and broken waves, a boat of ſuch a bulk could not prevail againſt them by the force of the oars; but the life-boat, from her peculiar form, may be rowed a-head, when the attempt in other boats would fail (B). Boats of the common form, adapted for ſpeed, are of courſe put in motion with a ſmall power; but for want of buoyancy and bearing, are overrun by the waves and ſunk, when impelled againſt them: and boats conſtructed for burthen, meet with too much reſiſtance from the wind and ſea, when oppoſed to them, and cannot in ſuch caſes be rowed from the ſhore to a ſhip in diſtreſs. An idea has been entertained that the ſuperior advantages of the life-boat are to be aſcribed ſolely to the quantity of cork affixed; but this is a very erroneous opinion, and I truſt has been amply refuted by the preceding obſervations on the conſtruction of this boat. It muſt be admitted that the application of cork to common boats would add to their buoyancy and ſecurity; and it might be a uſeful expedient, if there was a quantity of cork on board of ſhips, to prepare the boats with, in caſes of ſhipwreck, as it might be expeditiouſly done in a temporary way, by means of clamps, or ſome other contrivance. The application of cork to ſome of the boats of his majeſty's ſhips (the launches) might be worthy of conſideration, more particularly, as an experiment might be made at a little expence, and without injury to the boats.

"The life-boat is kept in a boat-houſe, and placed upon

(A) The ſhort oar is more manageable, in a high ſea, than the long oar, and its ſtroke is more certain.

(B) An extraordinary caſe might certainly happen, when a forcible combination of the wind, the waves, and the tide, might render it impracticable to row the life-boat from the ſhore.

Life-Boat. upon four low wheels, ready to be moved at a moment's notice. Theſe wheels are convenient in conveying the boat along the ſhore to the ſea; but if ſhe had to travel upon them, on a rough road, her frame would be exceedingly ſhaken; beſides, it has been found difficult and troubleſome to replace her upon theſe wheels, on her return from ſea.

"Another plan has therefore been adopted: two wheels of 12 feet diameter, with a moveable arched axis, and a pole fixed thereto, for a lever, have been conſtructed. The boat is ſuſpended, near her centre, between the wheels, under the axis; toward each extremity of which is an iron pin. When the pole is elevated perpendicularly, the upper part of the axis becomes depreſſed, and a pair of rope ſlings, which go round the boat, being fixed to the iron pins, ſhe is raiſed with the greateſt facility, by means of the pole, which is then faſtened down to the ſtem of the boat."

Temporary Life-*Boat*,—an invention by the reverend Mr Bremner miniſter of Walls and Flota in Orkney, by which any ordinary ſhips boat may be converted into a life-boat, ſo that in caſes of ſhipwreck, the crew may be ſaved by means of their own boats. Mr Bremner ſtates, in deſcribing his plan to the Highland Society of Scotland, that it had received the approbation of the Trinity houſes of London and Leith, of the Royal Humane Society of London, and of many captains of merchantmen. An experiment was made in the port of Leith under the ſuperintendance of Mr Bremner himſelf, and in preſence of a committee of the directors of the ſociety. This experiment proved ſatiſfactory to the committee, whoſe favourable report to the directors induced them to preſent Mr Bremner with a piece of plate in teſtimony of their approbation of his ſcheme. The following is a general deſcription of the method of preparing a boat for this purpoſe.

"The dimenſions of the ſloop's boat, with which the experiment was tried, were 14 feet in length, 5 feet 4 inches in width, and 2 feet 2 inches in depth. The only addition or previous preparation of the boat, was four ring bolts in the inſide, and two auger bores or holes in the outſide of the keel, as points of ſecurity for fixing the neceſſary ſeizing ropes (c). The ring bolts, within ſide the keel, were placed, the one forward, one-third from the ſtem, the other aft, one-third from the ſtern; the other two, the one directly at the ſtem, the other at the ſtern. The auger bores, outſide the keel, being half way betwixt the rings, viz. the one betwixt the two rings forward, the other betwixt the two rings aft.

"Two empty hogſheads were then placed in the fore part of the boat, parallel and cloſe to each other, and laid lengthways, fore and aft. Theſe were ſecured in their places by paſſing the ſeizing ropes round all, that is, over the gunwales and through the auger bore in the keel, as alſo from the ring bolt in the ſtem to that next it in the keel, taking care in doing this, to paſs the rope alſo through eyes on the ſlings of the caſks, which had been previouſly prepared. The ſame proceſs was obſerved in the after part of the boat. And laſtly, a bar of iron about three hundred weight, was fixed to the keel, on the inſide. A ſmall quantity of cork was alſo placed in the ſtern, intended chiefly to raiſe to a proper height the caſks placed above it, but without which the reſult of the experiment would have been the ſame. Life-Boat.

"The quantity of cork neceſſary, which will depend on the ſize of the boat, is to be made up into ſeveral parcels, but none larger than one perſon can eaſily manage. Each parcel to be properly ſecured and numbered, ſo as that the whole may fit and fill up the boat completely, in the ſpaces betwixt the ring bolts, fore and aft, as above deſcribed; and to anſwer the end, it is material that there ſhould be cork enough to riſe nearly three feet above the gunwales, ſo as to form an arch from gunwale to gunwale. The cork being thus laid in the boat, it is to be properly ſecured, firſt by paſſing a ſtrong rope round all, over the gunwales, and through the auger bore, outſide the keel; as alſo by paſſing ſeizing ropes from the ring bolt in the ſtem, to that next it in the keel, taking care to make as many turns and ſeizings betwixt theſe ring bolts, as completely to ſecure the cork from ſlipping out. The very ſame thing to be done as to the rope round the gunwales, and through the hole outſide the keel, with ſeizing ropes from the ring bolts, to be made aft, or in the ſtern of the boat.

"Where cork cannot be had, or may not be kept in readineſs on account of its expence, which, however, is not very great, caſks will anſwer the purpoſe, though it may be doubtful whether there would not be a greater chance that the fury of the waves might unlooſe them, unleſs particular care was taken to have them properly fixed. In the caſe of caſks, two empty ones are to be placed in the fore part of the boat, parallel to one another, cloſe together, and to be laid lengthwiſe fore and aft. Two other empty caſks to be placed in the ſame way in the ſtern, or aft part of the boat, and the whole to be ſecured as firmly and compactly as poſſible, by ſtrong ropes round the boat and caſks, and alſo by ſeizing ropes in the ſame way as deſcribed in the caſe of cork; then two other empty caſks, of the ſame dimenſions, one fore, and another aft, to be placed over and in the middle between the two already fixed, and to be firmly ſecured, as above-mentioned.

"As the boat is to be thus prepared on the deck of the ſhip, when danger appears, a piece of ſail ſhould be thrown in below, betwixt, and about the caſks, for the more effectually ſecuring them, and to prevent the ſeizing ropes from ſo readily ſlipping; it would be proper alſo to have ſlings on the caſks, with eyes in them, through which to paſs the ſeizing ropes.

"Laſtly, both in the caſe of cork and caſks, an iron bar, of about three hundred weight, for ſuch a boat as above deſcribed, ſhould be ſecured to the keel on the inſide, in the middle or empty ſpace. This middle, or empty ſpace of the boat, is for the ſailors, and in a ſhip's boat of the common ſize may hold eight people, with room to work a pair of oars. Every thing being previouſly

(c) It is probable, that ring bolts fixed in the gunwales, might anſwer as well as paſſing the ropes round the bottom of the boat and through the auger bores in the keel.

previoufly ready, it is certain that the neceffary fixing of the cafks will not take up above ten or twelve minutes, and it is obvious the cork can be fixed in a much fhorter period. It is alfo completely afcertained, that a boat fo prepared, though full of water, will not fink, but on the contrary be extremely buoyant, and will eafily go a-head: That it would be next to impoffible the boat fhould overfet; but, in cafe of this at any time happening, fhe would inftantly return to her proper pofition on her keel. Though the experiment was tried only with cafks, with but a fmall quantity of cork, as before ftated, yet it is generally believed, and and Mr Bremner himfelf is of the fame opinion, that it might anfwer equally well, and perhaps better, to have the cork or cafks ftowed in midfhips, leaving an empty fpace in each end, by which means the management of the boat by the helm or rudder would be preferved, though the other plan feems better, in the view of ufing oars.

Vegetable Life. See Plants.

Life-*Rent*, in *Scots Law*. When the ufe and enjoyment of a fubject is given to a perfon during his life, it is faid to belong to him in life-rent.

LIGAMENT, in its general fenfe, denotes any thing that ties or binds one part to another.

Ligament, in *Anatomy*, a ftrong compact fubftance, ferving to join two bones together. See Anatomy, N° 7.

LIGARIUS, Quintus, a Roman proconful in Africa, 49 B. C. Taking part with Pompey, he was forbid by Julius Cæfar to return to Rome: to obtain his pardon, Cicero made that admired oration in his defence, which has immortalized the memory of the client with that of his celebrated advocate.

LIGATURE, in *Surgery*, is a cord, band, or ftring; or the binding any part of the body with a cord, band, fillet, &c. whether of leather, linen, or any other matter.

Ligatures are ufed to extend or replace bones that are broken or diflocated; to tie the patients down in lithotomy and amputations; to tie upon the veins in phlebotomy, on the arteries in amputations, or in large wounds; to fecure the fplints that are applied to fractures; to tie up the proceffes of the peritonæum with the fpermatic veffels in caftration; and, laftly, in taking off warts or other excrefcences by ligature.

Ligature, is alfo ufed to fignify a kind of bandage or fillet, tied round the neck, arm, leg, or other part of the bodies of men or beafts, to divert or drive off fome difeafe, accident, &c.

Ligature, is alfo ufed for a ftate of impotency, in refpect to venery, pretended to be caufed by fome charm or witchcraft.

Kæmpfer tells of an uncommon kind of ligature or knotting, in ufe among the people of Macaffar, Java, Malacca, Siam, &c. By this charm or fpell, a man binds up a woman, and a woman a man, fo as to put it out of their power to have to do with any other perfon; the man being thereby rendered impotent to any other woman, and all other men impotent with refpect to the woman.

Some of their philofophers pretend, that this ligature may be effected by the fhutting of a lock, the drawing of a knot, or the fticking of a knife in the wall, at the point of time wherein the prieft is joining a couple together; and that a ligature, thus effected, may be diffolved, by the fpoufe's urining through a ring. This piece of fuperftition is faid to obtain alfo among the Chriftians of the Eaft.

The fame author tells us, that during the ceremony of marriage in Ruffia, he obferved an old fellow lurking behind the church-door, and mumbling over a ftring of words; and, at the fame time, cutting a long rod, which he held under his arm into pieces; which, it feems, is a common practice at the marriages of great perfons, and done with defign to elude and counterwork any other perfon that might poffibly be inducing the ligature.

The fecret of inducing a ligature is delivered by the fame author, as he was taught it on the fpot by one of their adepts: but it is too abfurd and obfcene to deferve being tranfcribed here.

M. Marfhal mentions a ridiculous form of ligature, which he received from a bramin of Indoftan: "If (fays he) the little worm in the wood lukerara kara be cut into two, and the one part ftirs and the other not, if the ftirring part be bruifed, and given with half a beetle to a man, and the other half to a woman, the charm will keep each from ever having to do with any other perfon. Phil. Tranf. N° 268.

Ligature, in the Italian mufic, fignifies a tying or binding together of notes. Hence fyncopes are often called *ligatures*, becaufe they are made by the ligature of many notes. There is another fort of ligatures for breves, when there are many of thefe on different lines, or on different fpaces, to be fung to one fyllable.

Ligatures, among printers, are types confifting of two letters or characters joined together; as *ct*, *&*, *ff*, *fl*, *fi*. The old editions of Greek authors are extremely full of ligatures; the ligatures of Stephens are by much the moft beautiful.—Some editions have been lately printed without any ligatures at all; and there was a defign to explode them quite out of printing. Had this fucceeded, the fineft ancient editions would in time have grown ufelefs: and the reading of old manufcripts would have been rendered almoft impracticable to the learned themfelves.

LIGHT, in the moft common acceptation of the word, fignifies that invifible etherial matter which makes objects perceptible to our fenfe of feeing. Figuratively, it is alfo ufed for whatever conveys inftruction to our minds, and likewife for that inftruction itfelf.

For an account of the chemical properties of light, fee Chemistry *Index*; and for its phyfical properties, fee Optics.

Light *independent of Heat*. In general, a very confiderable degree of heat is requifite to the emiffion of light from any body; but there are feveral exceptions to this, efpecially in light proceeding from putrefcent fubftances and phofphorus, together with that of luminous animals, and other fimilar appearances. Light proceeding from putrefcent animal and vegetable fubftances, as well as from glow-worms, is mentioned by Ariftotle. Thomas Bartholin mentions four kinds of luminous infects, two with wings, and two without; but in hot climates travellers fay they are found in much greater numbers, and of different fpecies.

De luce animal. p. 183, 206.

Light. cies. Columna, an induſtrious naturaliſt, obſerves, that their light is not extinguiſhed immediately upon the death of the animal.

Light from putrid fleſh. The firſt diſtinct account that we meet with of light proceeding from putreſcent animal fleſh is that which is given by Fabricius ab Aquapendente; who ſays, that when three Roman youths, reſiding at Padua, had bought a lamb, and had eaten part of it on Eaſter day 1562, ſeveral pieces of the remainder, which they kept till the day following, ſhone like ſo many candles when they were caſually viewed in the dark. Part of this luminous fleſh was immediately ſent to Aquapendente, who was profeſſor of anatomy in that city. He obſerved, that both the lean and the fat of this meat ſhone with a whitiſh kind of light; and alſo took notice, that ſome pieces of kid's fleſh, which had happened to have lain in contact with it, were luminous, as well as the fingers and other parts of the bodies of thoſe perſons who touched it. Thoſe parts, he obſerved, ſhone the moſt which were ſoft to the touch, and ſeemed to be tranſparent in candle light; but where the fleſh was thick and ſolid, or where a bone was near the outſide, it did not ſhine. *De Viſione*, p. 45.

After this appearance, we find no account of any other ſimilar to it, before that which was obſerved by Bartholin, and of which he gives a very pompous deſcription in his ingenious treatiſe already quoted. This happened at Montpelier in 1641, when a poor old woman had bought a piece of fleſh in the market, intending to make uſe of it the day following. But happening not to be able to ſleep well that night, and her bed and pantry being in the ſame room, ſhe obſerved ſo much light come from the fleſh, as to illuminate all the place where it hung. A part of this luminous fleſh was carried as a curioſity to Henry Bourbon, duke of Condé, the governor of the place, who viewed it for ſeveral hours with the greateſt aſtoniſhment.

This light was obſerved to be whitiſh; and not to cover the whole ſurface of the fleſh, but certain parts only, as if gems of unequal ſplendour had been ſcattered over it. This fleſh was kept till it began to putrefy, when the light vaniſhed; which, as ſome religious people fancied, it did in the form of a croſs.

It is natural to expect, that the almoſt univerſal experimental philoſopher Mr Boyle ſhould try the effect of his air-pump upon theſe luminous ſubſtances. Accordingly, we find that he did not fail to do it; when he preſently found that the light of rotten wood was extinguiſhed *in vacuo*, and revived again on the admiſſion of the air, even after a long continuance *in vacuo*; but the extinguiſhing of this light was not ſo complete immediately upon exhauſting the receiver, as ſome little time afterwards. He could not perceive, however, that the light of rotten wood was increaſed in condenſed air; but this, he imagined, might ariſe from his not being able to judge very well of the degree of light, through ſo thick and cloudy a glaſs veſſel as he then made uſe of; but we find that the light of a ſhining fiſh, which was put into a condenſing engine before the Royal Society, in 1668, was rendered more vivid by that means. The principal of Mr Boyle's experiments were made in October 1667. *Works*, vol. iii. p. 156. *Birch's hiſt.* ii. 254.

This philoſopher attended to a great variety of circumſtances relating to this curious phenomenon. Among other things he obſerved, that change of air was not neceſſary to the maintenance of this light; for it continued a long time when a piece of the wood was put into a very ſmall glaſs hermetically ſealed, and it made no difference when this tube which contained the wood was put into an exhauſted receiver. This he alſo obſerved with reſpect to a luminous fiſh, which he put into water, and placed in the ſame circumſtances. He alſo found, that the light of ſhining fiſhes had other properties in common with that of ſhining wood; but the latter, he ſays, was preſently quenched with water, ſpirit of wine, a greater variety of ſaline mixtures, and other fluids. Water, however, did not quench all the light of ſome ſhining veal on which he tried it, though ſpirit of wine deſtroyed its virtue preſently. Light.

Mr Boyle's obſervation of light proceeding from fleſh meat was quite caſual. On the 15th of Februaary 1662, one of his ſervants was greatly alarmed with the ſhining of ſome veal, which had been kept a few days, but had no bad ſmell, and was in a ſtate very proper for uſe. The ſervant immediately made his maſter acquainted with this extraordinary appearance; and though he was then in bed, he ordered it to be immediately brought to him, and he examined it with the greateſt attention. Suſpecting that the ſtate of the atmoſphere had ſome ſhare in the production of this phenomenon, he takes notice, after deſcribing the appearance, that the wind was ſouth-weſt and bluſtering, the air hot for the ſeaſon, the moon was paſt its laſt quarter, and the mercury in the barometer was at $29\frac{1}{10}$th inches. *Birch*, iii. 70.

Light from fiſhes. Mr Boyle was often diſappointed in his experiments on ſhining fiſhes; finding that they did not always ſhine in the very ſame circumſtances, as far as he could judge, with others which had ſhined before. At one time that they failed to ſhine, according to his expectations, he obſerved that the weather was variable, and not without ſome days of froſt and ſnow. In general he made uſe of whitings, finding them the fitteſt for his purpoſe. In a diſcourſe, however, upon this ſubject at the Royal Society in 1681, it was aſſerted, that, of all fiſhy ſubſtances, the eggs of lobſters, after they had been boiled, ſhone the brighteſt. Olig. Jacobœus obſerves, that, upon opening a ſea-polypus, it was ſo luminous as to ſtartle ſeveral perſons who ſaw it; and he ſays, that the more putrid the fiſh was, the more luminous it grew. The nails alſo, and the fingers of the perſons who touched it, became luminous; and the black liquor which iſſued from the animal, and which is its bile, ſhone alſo, but with a very faint light. *Act. Hafn.* vol. v. p. 282.

Mr Boyle draws a minute compariſon between the light of burning coals and that of ſhining wood or fiſh, ſhowing in what particulars they agree, and in what they differ. Among other things he obſerves, that extreme cold extinguiſhes the light of ſhining wood, as appeared when a piece of it was put into a glaſs tube, and held in a frigorific mixture. He alſo found that rotten wood did not waſte itſelf by ſhining, and that the application of a thermometer to it did not diſcover the leaſt degree of heat.

Of the pholas, a remarkably luminous fiſh. There is a remarkable ſhell-fiſh called PHOLAS, which forms for itſelf holes in various kinds of ſtone, &c. That this fiſh is luminous, was noticed by Pliny; who obſerves, Light. obſerves, that it ſhines in the mouth of the perſon who eats it, and, if it touch his hands or clothes, makes them luminous. He alſo ſays that the light depends upon its moiſture. The light of this fiſh has furniſhed matter for various obſervations and experiments to M. Reaumur, and the Bolognian academicians, eſpecially Beccarius, who took ſo much pains with the ſubject of phoſphoreal light.

M. Reaumur obſerves, that, whereas other fiſhes give light when they tend to putreſcence, this is more luminous in proportion to its being freſh; that when they are dried, their light will revive if they be moiſtened either with freſh or ſalt water, but that brandy immediately extinguiſhes it. He endeavoured to make this light permanent, but none of his ſchemes ſucceeded.

The attention of the Bolognian academicians was engaged to this ſubject by M. F. Marſilius, in 1724, who brought a number of theſe fiſhes, and the ſtones in which they were encloſed, to Bologna, on purpoſe for their examination.

Com. Bonon. vol. ii. 232. Beccarius obſerved, that though this fiſh ceaſed to ſhine when it became putrid; yet that in its moſt putrid ſtate, it would ſhine, and make the water in which it was immerſed luminous, when it was agitated. Galeatius and Montius found, that wine or vinegar extinguiſhed this light; that in common oil it continued ſome days; but in rectified ſpirit of wine or urine, hardly a minute.

In order to obſerve in what manner this light was affected by different degrees of heat, they made uſe of a Reaumur's thermometer, and found that water rendered luminous by theſe fiſhes increaſed in light till the heat arrived to 45 degrees; but that it then became ſuddenly extinct, and could not be revived.

In the experiments of Beccarius, a ſolution of ſea ſalt increaſed the light of the luminous water; a ſolution of nitre did not increaſe it quite ſo much. Sal ammoniac diminiſhed it a little, oil of tartar *per deliquium* nearly extinguiſhed it, and the acids entirely. This water poured upon freſh calcined gypſum, rock cryſtal, ceruſe, or ſugar, became more luminous. He alſo tried the effects of it when poured upon various other ſubſtances, but there was nothing very remarkable in them. Afterwards, uſing luminous milk, he found that oil of vitriol extinguiſhed the light, but that oil of tartar increaſed it.

This gentleman had the curioſity to try how differently coloured ſubſtances were affected by this kind of light; and having, for this purpoſe, dipped ſeveral ribbons in it, the white came out the brighteſt, next to this was the yellow, and then the green; the other colours could hardly be perceived. It was not, however, any particular colour, but only light that was perceived in this caſe. He then dipped boards painted with the different colours, and alſo glaſs tubes, filled with ſubſtances of different colours, in water rendered luminous by the fiſhes. In both theſe caſes the red was hardly viſible, the yellow was the brighteſt, and the violet the dulleſt. But on the boards the blue was nearly equal to the yellow, and the green more languid; whereas in the glaſſes, the blue was inferior to the green.

Of all the liquors into which he put the pholades, milk was rendered the moſt luminous. A ſingle pholas made ſeven ounces of milk ſo luminous, that the faces of perſons might be diſtinguiſhed by it, and it looked as if it was tranſparent. Light.

Air appeared to be neceſſary to this light; for when Beccarius put the luminous milk into glaſs tubes, no agitation would make it ſhine, unleſs bubbles of air were mixed with it. Alſo Montius and Galeatius found, that, in an exhauſted receiver, the pholas loſt its light, but the water was ſometimes made more luminous; which they aſcribed to the riſing of bubbles of air through it.

Beccarius, as well as Reaumur, had many ſchemes to render the light of theſe pholades permanent. For this purpoſe he kneaded the juice into a kind of paſte, with flour, and found that it would give light when it was immerſed in warm water; but it anſwered beſt to preſerve the fiſh in honey. In any other method of preſervation, the property of becoming luminous would not continue longer than ſix months, but in honey it had laſted above a year; and then it would, when plunged in warm water, give as much light as ever it had done.

Similar, in ſome reſpects, to thoſe obſervations on the light of the pholas, was that which was obſerved to proceed from wood which was moiſt, but not in a putrid ſtate, which was very conſpicuous in the dark. *Acta Cæſarenſia*, vol. v. p. 485.

Light from ſea water. That the ſea is ſometimes luminous, eſpecially when it is put in motion by the daſhing of oars or the beating of it againſt a ſhip, has been obſerved with admiration by a great number of perſons. Mr Boyle, after reciting all the circumſtances of this appearance, as far as he could collect them from the accounts of navigators; as its being extended as far as the eye could reach, and at other times being viſible only when the water was daſhed againſt ſome other body; that, in ſome ſeas, this phenomenon is accompanied by ſome particular winds, but not in others; and that ſometimes one part of the ſea will be luminous, when another part, not far from it, will not be ſo; concludes with ſaying, that he could not help ſuſpecting that theſe odd phenomena, belonging to great maſſes of water, were in ſome meaſure owing to ſome coſmical law or cuſtom of the terreſtrial globe, or at leaſt of the planetary vortex.

Dr Beale's experiments on fiſhes. Some curious obſervations on the ſhining of ſome fiſhes, and the pickle in which they were immerſed, were made by Dr Beale, in May 1665; and had they been properly attended to and purſued, might have led to the diſcovery of the cauſe of this appearance. Having put ſome boiled mackerel into water, together with ſalt and ſweet herbs; when the cook was, ſome time after, ſtirring it, in order to take out ſome of the fiſhes, ſhe obſerved, that, at the firſt motion, the water was very luminous; and that the fiſh ſhining through the water added much to the light which the water yielded. The water was of itſelf thick and blackiſh, rather than of any other colour; and yet it ſhined on being ſtirred, and at the ſame time the fiſhes appeared more luminous than the water. Wherever the drops of this water, after it had been ſtirred, fell to the ground, they ſhined; and the children in the family diverted themſelves with taking the drops, which were as broad as a penny, and running with them about the houſe. The cook obſerved, that, when ſhe turned up that ſide of the fiſh that was loweſt, no light came from it; *Phil. Tranſ.* vol. lix. p. 450.

Light.

it; and that, when the water had settled for some time, it did not shine at all. The day following, the water gave but little light, and only after a brisk agitation, though the fishes continued to shine as well from the inside as the outside, and especially about the throat, and such places as seemed to have been a little broken in the boiling.

When in the light of the sun, he examined, with a microscope, a small piece of a fish which had shined very much the night before, he found nothing remarkable on its surface, except that he thought he perceived what he calls a *steam*, rather dark than luminous, arising like a very small dust from the fish, and here and there a very small and almost imperceptible sparkle. Of the sparkles he had no doubt; but he thought it possible that the steam might be a deception of the sight, or some dust in the air.

Finding the fish to be quite dry, he moistened it with his spittle; and then observed that it gave a little light, though but for a short time. The fish at that time was not fetid, nor yet insipid to the best discerning palate. Two of the fishes he kept two or three days longer for farther trial: but, the weather being very hot, they became fetid: and, contrary to his expectations, there was no more light produced either by the agitation of the water or in the fish.

Father Bourzes's account of luminous sea water.

Father Bourzes, in his voyage to the Indies in 1704, took particular notice of the luminous appearance of the sea. The light was sometimes so great, that he could easily read the title of a book by it, though he was nine or ten feet from the surface of the water. Sometimes he could easily distinguish, in the wake of a ship, the particles that were luminous from those that were not; and they appeared not to be all of the same figure. Some of them were like points of light, and others such as stars appear to the naked eye. Some of them were like globes, of a line or two in diameter; and others as big as one's head. Sometimes they formed themselves into squares of three or four inches long, and one or two broad. Sometimes all these different figures were visible at the same time; and sometimes they were what he calls *vortices* of light, which at one particular time appeared and disappeared immediately like flashes of lightning.

Nor did only the wake of the ship produce this light, but fishes also, in swimming, left so luminous a track behind them, that both their size and species might be distinguished by it. When he took some of the water out of the sea, and stirred it ever so little with his hand, in the dark, he always saw in it an infinite number of bright particles; and he had the same appearance whenever he dipped a piece of linen in the sea, and wrung it in a dark place, even though it was half dry; and he observed, that when the sparkles fell upon any thing that was solid, it would continue shining for some hours together.

His conjectures concerning the cause.

After mentioning several circumstances which did not contribute to this appearance, this father observes, that it depends very much upon the *quality of the water;* and he was pretty sure that this light is the greatest when the water is fattest, and fullest of foam. For in the main sea, he says, the water is not everywhere equally pure; and that sometimes, if linen be dipped in the sea, it is clamny when it is drawn up again: and he often observed, that when the wake of the ship was the brightest, the water was the most fat and glutinous, and that linen moistened with it produced a great deal of light, if it was stirred or moved briskly. Besides, in some parts of the sea, he saw a substance like saw dust, sometimes red and sometimes yellow; and when he drew up the water in those places, it was always viscous and glutinous. The sailors told him, that it was the spawn of whales; that there are great quantities of it in the north; and that sometimes, in the night, they appeared all over of a bright light, without being put in motion by any vessel or fish passing by them.

As a confirmation of this conjecture, that the more glutinous the sea water is, the more it is disposed to become luminous, he observes, that one day they took a fish which was called a *bonite*, the inside of the mouth of which was so luminous, that, without any other light, he could read the same characters which he had before read by the light in the wake of the ship; and the mouth of this fish was full of a viscous matter, which, when it was rubbed upon a piece of wood, made it immediately all over luminous; though, when the moisture was dried up, the light was extinguished.

Abbe Nollet's theory.

The abbé Nollet was much struck with the luminousness of the sea when he was at Venice in 1749; and, after taking a great deal of pains to ascertain the circumstances of it, concluded that it was occasioned by a shining insect; and having examined the water very often, he at length did find a small insect, which he particularly describes, and to which he attributes the light. The same hypothesis had also occurred to M. Vianelli, professor of medicine in Chioggia near Venice; and both he and M. Grizellini, a physician in Venice, have given drawings of the insects from which they imagined this light to proceed.

The abbé was the more confirmed in his hypothesis, by observing, some time after, the motion of some luminous particles in the sea. For, going into the water, and keeping his head just above the surface, he saw them dart from the bottom, which was covered with weeds, to the top, in a manner which he thought very much resembled the motions of insects; though, when he endeavoured to catch them, he only found some luminous spots upon his handkerchief, which were enlarged when he pressed them with his finger.

Observations of M. le Roi.

Memoires Presentes, vol. iii. 144.

M. le Roi, making a voyage on the Mediterranean, presently after the abbé Nollet made his observations at Venice, took notice, that in the day time, the prow of the ship in motion threw up many small particles, which, falling upon the water, rolled upon the surface of the sea for a few seconds before they mixed with it; and in the night the same particles, as he concluded, had the appearance of fire. Taking a quantity of the water, the same small sparks appeared whenever it was agitated; but, as was observed with respect to Dr Beale's experiments, every successive agitation produced a less effect than the preceding, except after being suffered to rest a while; for then a fresh agitation would make it almost as luminous as the first. This water, he observed, would retain its property of shining by agitation a day or two; but it disappeared immediately on being set on the fire, though it was not made to boil.

This gentleman, after giving much attention to this phenomenon, concludes, that it is not occasioned by

Light.

any ſhining inſects, as the abbé Nollet imagined; eſpecially as, after carefully examining ſome of the luminous points, which he caught upon an handkerchief, he found them to be round like large pins heads, but with nothing of the appearance of any animal, though he viewed them with a microſcope. He alſo found, that the mixture of a little ſpirit of wine with water juſt drawn from the ſea, would give the appearance of a great number of little ſparks, which would continue viſible longer than thoſe in the ocean. All the acids, and various other liquors, produced the ſame effect, though not quite ſo conſpicuouſly; but no freſh agitation would make them luminous again. M. le Roi is far from aſſerting that there are no luminous inſects in the ſea. He even ſuppoſes that the abbé Nollet and M. Vianelli had found them. But he was ſatiſfied that the ſea is luminous chiefly on ſome other account, though he does not ſo much as advance a conjecture about what it is.

Experiments by M. Ant. Martin.

M. Ant. Martin made many experiments on the light of fiſhes, with a view to diſcover the cauſe of the light of the ſea. He thought that he had reaſon to conclude, from a great variety of experiments, that all ſea fiſhes have this property; but that it is not to be found in any that are produced in freſh water. Nothing depended upon the colour of the fiſhes, except that he thought that the white ones, and eſpecially thoſe that had white ſcales, were a little more luminous than others. This light, he found, was increaſed by a ſmall quantity of ſalt; and alſo by a ſmall degree of warmth, though a greater degree extinguiſhed it. This agrees with another obſervation of his, that it depends entirely upon a kind of moiſture which they had about them, and which a ſmall degree of heat would expel, when an oilineſs remained which did not give this light, but would burn in the fire. Light from the fleſh of birds or beaſts is not ſo bright, he ſays, as that which proceeds from fiſh. Human bodies, he ſays, have ſometimes emitted light about the time that they began to putrefy, and the walls and roof of a place in which dead bodies had often been expoſed, had a kind of dew or clamminеſs upon it, which was ſometimes luminous; and he imagined that the lights which are ſaid to be ſeen in burying-grounds may be owing to this cauſe.

Swed. Abhand. vol. xxiii. p. 225.

By Mr Canton.

From ſome experiments made by Mr Canton, he concludes, that the luminouſneſs of ſea water is owing to the ſlimy and other putreſcent ſubſtances it contains. On the evening of the 14th of June 1768, he put a ſmall freſh whiting into a gallon of ſea water, in a pan which was about 14 inches in diameter, and took notice that neither the whiting nor the water, when agitated, gave any light. A Fahrenheit's thermometer, in the cellar where the pan was placed, ſtood at 54°. The 15th, at night, that part of the fiſh which was even with the ſurface of the water was luminous, but the water itſelf was dark. He drew the end of a ſtick through it, from one ſide of the pan to the other; and the water appeared luminous behind the ſtick all the way, but gave light only where it was diſturbed. When all the water was ſtirred, the whole became luminous, and appeared like milk, giving a conſiderable degree of light to the ſides of the pan; and it continued to do ſo for ſome time after it was at reſt. The water was moſt luminous when the fiſh had been in it about 28 hours; but would not give any light by being ſtirred, after it had been in it three days.

He then put a gallon of freſh water into one pan, and an equal quantity of ſea water into another; and into each pan he put a freſh herring of about three ounces. The next night the whole ſurface of the ſea water was luminous without being ſtirred; but it was much more ſo when it was put in motion; and the upper part of the herring, which was conſiderably below the ſurface of the water, was alſo very bright; while at the ſame time the freſh water, and the fiſh that was in it, were quite dark. There were ſeveral very bright luminous ſpots on different parts of the ſurface of the ſea water; and the whole, when viewed by the light of a candle, ſeemed covered with a greaſy ſcum. The third night, the light of the ſea water while at reſt, was very little, if at all leſs than before; but when ſtirred, its light was ſo great as to diſcover the time by a watch, and the fiſh in it appeared as a dark ſubſtance. After this, its light was evidently decreaſing, but was not quite gone before the 7th night. The freſh water and the fiſh in it were perfectly dark during the whole time. The thermometer was generally above 60°.

The preceding experiments were made with ſea water: but he now made uſe of other water, into which he put common or ſea ſalt, till he found, by an hydrometer, that it was of the ſame ſpecific gravity with the ſea water; and, at the ſame time, in another gallon of water, he diſſolved two pounds of ſalt; and into each of theſe waters he put a ſmall freſh herring. The next evening the whole ſurface of the artificial ſea water was luminous without being ſtirred; but gave much more light when it was diſturbed. It appeared exactly like the real ſea water in the preceding experiment; its light laſted about the ſame time, and went off in the ſame manner: while the other water, which was almoſt as ſalt as it could be made, never gave any light. The herring which was taken out of it the ſeventh night, and waſhed from its ſalt, was found firm and ſweet; but the other herring was very ſoft and putrid, much more ſo than that which had been kept as long in freſh water. If a herring, in warm weather, be put into 10 gallons of artificial ſea water, inſtead of one, the water, he ſays, will ſtill become luminous, but its light will not be ſo ſtrong.

It appeared by ſome of the firſt obſervations on this ſubject, that *heat* extinguiſhes the light of putreſcent ſubſtances. Mr Canton alſo attended to this circumſtance; and obſerves, that though the greateſt ſummer heat is well known to promote putrefaction, yet 20 degrees more than that of the human blood ſeems to hinder it. For putting a ſmall piece of a luminous fiſh into a thin glaſs ball, he found, that water of the heat of 118 degrees would extinguiſh its light in leſs than half a minute; but that, on taking it out of the water, it would begin to recover its light in about 10 ſeconds; but it was never afterwards ſo bright as before.

Mr Canton made the ſame obſervation that Mr Ant. Martin had done, viz. that ſeveral kinds of river fiſh could not be made to give light, in the ſame circumſtances in which any ſea fiſh became luminous. He ſays, however, that a piece of carp made the water very luminous,

Light.

luminous, though the outſide, or ſcaly part of it, did not ſhine at all.

For the ſake of thoſe perſons who may chooſe to repeat his experiments, he obſerves, that artificial ſea water may be made without the uſe of an hydrometer, by the proportion of four ounces avoirdupois of ſalt to ſeven pints of water, wine meaſure.

A very elaborate paper on the ſubject by Dr Hulme appeared in the Philoſophical Tranſactions for 1800, to which we refer our readers, and to CHEMISTRY, p. 451.

The ocean luminous from inſects.

From undoubted obſervations, however, it appears, that in many places of the ocean it is covered with luminous inſects to a very conſiderable extent. M. Dagelet, a French aſtronomer who returned from the Terra Auſtralis in the year 1774, brought with him ſeveral kinds of worms which ſhine in water when it is ſet in motion; and M. Rigaud, in a paper inſerted (if we are not miſtaken) in the Journal des Sçavans for the month of March 1770, affirms, that the luminous ſurface of the ſea, from the port of Breſt to the Antilles, contains an immenſe quantity of little, round, ſhining polypuſes of about a quarter of a line in diameter. Other learned men, who acknowledge the exiſtence of theſe luminous animals, cannot, however, be perſuaded to conſider them as the cauſe of all that light and ſcintillation that appear on the ſurface of the ocean: they think that ſome ſubſtance of the phoſphorus kind, ariſing from putrefaction, muſt be admitted as one of the cauſes of this phenomenon. M. Godehoue has publiſhed curious obſervations on a kind of fiſh called in French *bonite*, already mentioned; and though he has obſerved, and accurately deſcribed, ſeveral of the luminous inſects that are found in ſea water, he is, nevertheleſs, of opinion, that the ſcintillation and flaming light of the ſea proceed from the oily and greaſy ſubſtances with which it is impregnated.

The abbé Nollet was long of opinion, that the light of the ſea proceeded from electricity (A); though he afterwards ſeemed inclined to think, that this phenomenon was cauſed by ſmall animals, either by their luminous aſpect, or at leaſt by ſome liquor or effluvia which they emitted. He did not, however, exclude other cauſes; among theſe, the ſpawn or fry of fiſh deſerves to be noticed. M. Dagelet, ſailing into the bay of Antongil, in the iſland of Madagaſcar, obſerved a prodigious quantity of fry which covered the ſurface of the ſea above a mile in length, and which he at firſt took for banks of ſand on account of their colour; they exhaled a diſagreeable odour, and the ſea had appeared with uncommon ſplendor ſome days before. The ſame accurate obſerver, perceiving the ſea remarkably luminous in the road of the Cape of Good Hope during a perfect calm, remarked, that the oars of the canoes produced a whitiſh and pearly kind of luſtre; when he took in his hand the water which contained this phoſphorus, he diſcerned in it, for ſome minutes, globules of light as large as the heads of pins. When he preſſed theſe globules, they appeared to his touch like a ſoft and thin pulp; and ſome days after the ſea was covered near the coaſts with whole banks of theſe little fiſh in innumerable multitudes.

To putrefaction, alſo, ſome are willing to attribute that luminous appearance which goes by the name of *ignis fatuus*, to which the credulous vulgar aſcribe very extraordinary and eſpecially miſchievous powers. It is moſt frequently obſerved in boggy places and near rivers, though ſometimes alſo in dry places. By its appearance benighted travellers are ſaid to have been ſometimes miſled into marſhy places, taking the light which they ſaw before them for a candle at a diſtance; from which ſeemingly miſchievous property it has been thought by the vulgar to be a ſpirit of a malignant nature, and been named accordingly *Will with a wiſp*, or *Jack with a lanthorn;* for the ſame reaſon alſo it probably had its Latin name *ignis fatuus*.

Ignis fatuus.

This kind of light is ſaid to be frequent about burying places and dunghills. Some countries are alſo remarkable for it, as about Bologna in Italy, and ſome parts of Spain and Ethiopia. Its forms are ſo uncertain and variable that they can ſcarce be deſcribed, eſpecially as few philoſophical obſervers ever had the good fortune to meet with it. Dr Derham, however, happened one night to perceive one of them, and got ſo near that he could have a very advantageous view of it. This is by no means eaſy to be obtained; for, among other ſingularities of the *ignis fatuus*, it is obſerved to avoid the approach of any perſon, and fly from place to place as if it was animated. That which Dr Derham obſerved was in ſome boggy ground betwixt two rocky hills; and the night was dark and calm; by which means, probably, he was enabled to advance within two or three yards of it. It appeared like a complete body of light without any diviſion, ſo that he was ſure it could not be occaſioned by inſects as ſome have ſuppoſed; the ſeparate lights of which he could not have failed to diſtinguiſh, had it been occaſioned by them. The light kept dancing about a dead thiſtle, till a very ſlight motion of the air, occaſioned, as he ſuppoſed, by his near approach to it, made it jump to another place; after which it kept flying before him as he advanced. M. Beccaria endeavoured to procure all the intelligence he could concerning this phenomenon, by inquiring of all his acquaintance who might have had an opportunity of obſerving it. Thus he obtained information that two of theſe lights appeared in the plains about Bologna, the one to the north, and the other to the ſouth, of that city, and were to be ſeen almoſt every dark night, eſpecially that to the eaſtward, giving a light equal to an ordinary faggot. The latter appeared to a gentleman of his acquaintance as he was travelling; moved conſtantly before him for about a mile; and gave a better light than a torch which was carried before him. Both theſe appearances gave a very ſtrong light, and were conſtantly in motion, though this various and uncertain. Sometimes they would riſe, ſometimes ſink; but commonly they would hover about ſix feet from the ground; they would alſo frequently diſappear on a ſudden,

(A) This hypotheſis was alſo maintained in a treatiſe publiſhed at Venice in 1746, by an officer in the Auſtrian ſervice, under the title, *Dell' Eletreciſmo*.

den, and appear again in ſome other place. They differed alſo in ſize and figure, ſometimes ſpreading pretty wide, and then contracting themſelves; ſometimes breaking into two, and then joining again. Sometimes they would appear like waves, at others they would ſeem to drop ſparks of fire: they were but little affected by the wind; and in wet and rainy weather were frequently obſerved to caſt a ſtronger light than in dry weather: they were alſo obſerved more frequently when ſnow lay upon the ground, than in the hotteſt ſummer; but he was aſſured that there was not a dark night throughout the whole year in which they were not to be ſeen. The ground to the eaſtward of Bologna, where the largeſt of theſe appearances was obſerved, is a hard chalky ſoil mixed with clay, which will retain the moiſture for a long time, but breaks and cracks in hot weather. On the mountains, where the ſoil is of a looſer texture, and leſs capable of retaining moiſture, the *ignes fatui* were leſs.

From the beſt information which M. Beccaria was able to procure, he found that theſe lights were very frequent about rivers and brooks. He concludes his narrative with the following ſingular account: "An intelligent gentleman travelling in the evening, between eight and nine, in a mountainous road about ten miles ſouth of Bologna, perceived a light which ſhone very ſtrangely upon ſome ſtones which lay on the banks of the river Rioverde. It ſeemed to be about two feet above the ſtones, and not far from the water. In ſize and figure it had the appearance of a parallelopiped, ſomewhat more than a foot in length, and half a foot high, the longeſt ſide being parallel to the horizon. Its light was ſo ſtrong, that he could plainly diſcern by it part of a neighbouring hedge and the water of the river; only in the eaſt corner of it the light was rather faint, and the ſquare figure leſs perfect, as if it was cut off or darkened by the ſegment of a circle. On examining it a little nearer, he was ſurpriſed to find that it changed gradually from a bright red, firſt to a yellowiſh, and then to a pale colour, in proportion as he drew nearer; and when he came to the place itſelf, it quite vaniſhed. Upon this he ſtepped back, and not only ſaw it again, but found that the farther he went from it, the ſtronger and brighter it grew. When he examined the place of this luminous appearance, he could perceive no ſmell nor any other mark of fire." This account was confirmed by another gentleman, who informed M. Beccaria, that he had ſeen the ſame light five or ſix different times in ſpring and in autumn; and that it always appeared of the ſame ſhape, and in the very ſame place. One night in particular, he obſerved it come out of a neighbouring field to ſettle in the uſual place.

A very remarkable account of an *ignis fatuus* is given by Dr Shaw in his Travels to the Holy Land. It appeared in the valleys of Mount Ephraim, and attended him and his company for more than an hour. Sometimes it would appear globular, or in the ſhape of the flame of a candle; at others it would ſpread to ſuch a degree as to involve the whole company in a pale inoffenſive light, then contract itſelf, and ſuddenly diſappear; but in leſs than a minute would appear again; ſometimes running ſwiftly along, it would expand itſelf at certain intervals over more than two or three acres of the adjacent mountains. The atmoſphere from the beginning of the evening had been remarkably thick and hazy; and the dew, as they felt it on the bridles of their horſes, was very clammy and unctuous.

Lights reſembling the *ignis fatuus* are ſometimes obſerved at ſea, ſkipping about the maſts and rigging of ſhips; and Dr Shaw informs us, that he has ſeen theſe in ſuch weather as that juſt mentioned when he ſaw the *ignis fatuus* in Paleſtine. Similar appearances have been obſerved in various other ſituations; and we are told of one which appeared about the bed of a woman in Milan, ſurrounding it as well as her body entirely. This light fled from the hand which approached it; but was at length entirely diſperſed by the motion of the air. Of the ſame kind alſo, moſt probably, are thoſe ſmall luminous appearances which ſometimes appear in houſes or near them, called in Scotland *Elf candles*, and which are ſuppoſed to portend the death of ſome perſon about the houſe. In general theſe lights are harmleſs, though not always; for we have accounts of ſome luminous vapours which would encompaſs ſtacks of hay and corn, and ſet them on fire; ſo that they became objects of great terror and concern to the country people. Of theſe it was obſerved, that they would avoid a drawn ſword, or ſharp-pointed iron inſtrument, and that they would be driven away by a great noiſe; both which methods were made uſe of to diſſipate them: and it was likewiſe obſerved, that they came from ſome diſtance, as it were on purpoſe to do miſchief.

Several philoſophers have endeavoured to account for theſe appearances, but hitherto with no great ſucceſs; nor indeed does there ſeem to be ſufficient data for ſolving all their phenomena. Willoughby, Ray, and others, have imagined that the light was occaſioned by a number of ſhining inſects; but this opinion was never ſupported in ſuch a manner as to gain much ground. The *ignis fatuus* ſeen by Dr Derham above mentioned, as well as all the other inſtances we have related ſeem to demonſtrate the contrary. Sir Iſaac Newton calls it a vapour ſhining without heat; and ſuppoſes that there is the ſame difference between the vapour of *ignis fatuus* and flame, that there is between the ſhining or rotten wood and burning coals. But though this ſeems generally to be the caſe, there are ſtill ſome exceptions, as has been inſtanced in the vapours which ſet fire to the ſtacks of corn. Dr Prieſtley ſuppoſes that the light is of the ſame nature with that produced by putreſcent ſubſtances; and others are of opinion, that the electrical fluid is principally concerned; but none have attempted to give any particular ſolution of the phenomena.

From the frequent appearance of the *ignis fatuus* in marſhes, moiſt ground, burying places, and dunghills, we are naturally led to conclude, that putrefaction is concerned in the production of it. This proceſs, we know, is attended with the emiſſion of an aqueous ſteam, together with a quantity of fixed, inflammable, and azotic airs, all blended together in the form of vapour. It is likewiſe attended with ſome degree of heat; and we know that there are ſome vapours, that of ſulphur particularly, which become luminous, with a degree of heat much leſs than that ſufficient to ſet fire to combuſtible bodies. There is no inconſiſtency, therefore, in ſuppoſing that the putrid

vapour

vapour may be capable of ſhining with a ſtill ſmaller degree of heat than that of ſulphur, and conſequently become luminous by that which putrefaction alone affords. This would account for the *ignis fatuus*, were it only a ſteady luminous vapour ariſing from places where putrid matters are contained; but its extreme mobility, and flying from one place to another on the approach of any perſon, cannot be accounted for on this principle. If one quantity of the putrid vapour becomes luminous by means of heat, all the reſt ought to do ſo likewiſe; ſo that, though we may allow heat and putrefaction to be concerned, yet of neceſſity we muſt have recourſe to ſome other agent, which cannot be any other than electricity. Without this, it is impoſſible to conceive how any body of moveable vapour ſhould not be carried away by the wind; but ſo far is this from being the caſe, that the *ignes fatui*, deſcribed by M. Beccaria, were but little affected by the wind. It is beſides proved by undoubted experiment, that electricity always is attended with ſome degree of heat; and this, however ſmall, may be ſufficient to give a luminous property to any vapour on which it acts ſtrongly; not to mention, that the electric fluid itſelf is no other than that of light, and may therefore by its action eaſily produce a luminous appearance independent of any vapour.

We have a ſtrong proof that electricity is concerned, or indeed the principal agent, in producing the *ignis fatuus*, from an experiment related by Dr Prieſtley of a flame of this kind being artificially produced. A gentleman, who had been making many electrical experiments for a whole afternoon in a ſmall room, on going out of it, obſerved a flame following him at ſome little diſtance, This, we have no reaſon to doubt, was a true *ignis fatuus*, and the circumſtances neceſſary to produce it were then preſent, viz. an atmoſphere impregnated with animal vapour, and likewiſe ſtrongly electrified. Both theſe circumſtances undoubtedly muſt have taken place in the preſent caſe; for the quantity of perſpiration emitted by a human body is by no means inconſiderable; and it, as well as the electricity, would be collected by reaſon of the ſmallneſs of the room. In this caſe, however, there ſeems to have been a conſiderable difference between the artificial *ignis fatuus* and thoſe commonly met with; for this flame *followed* the gentleman as he went out of the room; but the natural ones commonly fly from thoſe who approach them. This may be accounted for, from a difference between the electricity of the atmoſphere in the one room and the other; in which caſe the flame would naturally be attracted towards that place where the electricity was either different in quality or in quantity; but in the natural way, where all bodies may be ſuppoſed equally electrified for a great way round, a repulſion will as naturally take place. Still, however, this does not ſeem to be always the caſe. In thoſe inſtances where travellers have been attended by an *ignis fatuus*, we cannot ſuppoſe it to have been influenced by any other power than what we call *attraction*, and which electricity is very capable of producing. Its keeping at ſome diſtance is likewiſe eaſily accounted for; as we know that bodies poſſeſſed of different quantities of electricity may be made to attract one another for a certain ſpace, and then repel without having ever come into contact. On this principle we may account for the light which ſurrounded the woman at Milan, but fled from the hand of any other perſon. On the ſame principle may we account for theſe miſchievous vapours which ſet fire to the hay and corn ſtacks, but were driven away by preſenting to them a pointed iron inſtrument, or by making a noiſe. Both theſe are known to have a great effect upon the electric matter; and by means of either, even lightning may occaſionally be made to fall upon or to avoid particular places, according to the circumſtances by which the general maſs happens to be affected at that time.

On the whole, therefore, it ſeems moſt probable, that the *ignis fatuus* is a collection of vapour of the putreſcent kind, very much affected by electricity; according to the degree of which, it will either give a weak or ſtrong light, or even ſet fire to certain ſubſtances diſpoſed to receive its operation. This opinion ſeems greatly to be confirmed from ſome luminous appearances obſerved in privies, where the putrid vapours have even collected themſelves into balls, and exploded violently on the approach of a candle. This laſt effect, however, we cannot ſo well aſcribe to the electricity, as to the accenſion of the inflammable air which frequently abounds in ſuch places.

In the appendix to Dr Prieſtley's third volume of Experiments and Obſervations on Air, Mr Warltire gives an account of ſome very remarkable *ignes fatui*, which he obſerved on the road to Bromſgrove, about five miles from Birmingham. The time of obſervation was the 12th of December 1776, before day-light. A great many of theſe lights were playing in an adjacent field, in different directions; from ſome of which there ſuddenly ſprung up bright branches of light, ſomething reſembling the exploſion of a rocket that contained many brilliant ſtars, if the diſcharge was upwards, inſtead of the uſual direction; and the hedge and trees on each ſide of the hedge were illuminated. This appearance continued but a few ſeconds, and then the jack-a-lanterns played as before. Mr Warltire was not near enough to obſerve if the apparent exploſions were attended with any report.

Cronſtedt gives it as his opinion, that *ignis fatuus*, as well as the meteors called *falling ſtars*, are owing to collections of inflammable air raiſed to a great height in the atmoſphere. But, with regard to the latter, the vaſt height at which they move evidently ſhows that they cannot be the effect of any *gravitating* vapour whatever; for the lighteſt inflammable air is one-twelfth of that of the common atmoſphere: and we have no reaſon to believe, that at the diſtance of 40 or 50 miles from the earth, the latter has near one-twelfth of its weight at the ſurface. From the account given by Mr Warltire, we ſhould be apt to conclude, that there is a ſtrong affinity betwixt the *ignes fatui* and fire balls, inſomuch that the one might be very eaſily converted into the other. From this then we muſt aſcribe an electrical origin to the one as well as the other. Electricity, we know, can aſſume both theſe appearances, as is evident in the caſe of points: or even when the atmoſphere is violently electrified, as around the ſtring of an electrical kite, which always will appear to be ſurrounded with a blue flame in the night, if the electricity be very ſtrong.

On the whole, it appears, that electricity acting upon

Light.

on a ſmall quantity of atmoſpherical air, with a certain degree of vigour, will produce an appearance reſembling an *ignis fatuus;* with a ſuperior force it will produce a fire ball; and a ſudden increaſe of electrical power might produce thoſe ſparks and apparent exploſions obſerved by Mr Warltire. The only difficulty therefore is, Why does electricity exert its power upon one portion of the atmoſphere rather than another, ſeeing it has an opportunity of diffuſing itſelf equally through the whole? To this it ſeems impoſſible to give any other reaſon than that we ſee the fact is ſo; and that in all caſes where there is a quantity of electrified air or vapour, there will be an accumulation in one part rather than another. Thus, in the experiment already related, where the gentleman perceived a blue flame following him, the whole air of the room was electrified, but the greateſt power of the fluid was exerted on that which gave the luminous appearance.

With regard to the uſes of the *ignes fatui* in the ſyſtem of nature, we can only ſay, that they ſeem to be accidental appearances reſulting from the motion of the electric fluid, and, no doubt, like other meteors ſubſervient to the preſervation of its equilibrium, and thus are uſeful in preventing thoſe dreadful commotions which enſue when a proper medium for ſo doing is deficient.

Phoſphoric light.

A light in ſome reſpects ſimilar to thoſe above mentioned has been found to proceed from that celebrated chemical production called *phoſphorus*, which always tends to decompoſe itſelf, ſo as to take fire by the acceſs of *air* only. Phoſphorus, therefore, when it emits light, is properly a body ignited; though when a very ſmall quantity of it is uſed, as what is left after drawing it over paper, or what may be diſſolved in eſſential oil, the heat is not ſenſible. But perhaps the matter which emits the light in what we call *putreſcent ſubſtances* may be ſimilar to it, though it be generated by a different proceſs, and burn with a leſs degree of heat. Putreſcence does not ſeem to be neceſſary to the light of glow-worms or of the pholades; and yet their light is ſufficiently ſimilar to that of ſhining wood or fleſh. Electric light is unqueſtionably ſimilar to that of phoſphorus, though the ſource of it is apparently very different.

Kunckel formed his phoſphorus into a kind of pills about the ſize of peas, which being moiſtened a little, and ſcraped in the dark, yielded a very conſiderable light, but not without ſmoke. The light was much more pleaſing when eight or ten of theſe pills were put into a glaſs of water; for being ſhaken in the dark, the whole glaſs ſeemed to be filled with light. Kunckel alſo reduced his phoſphorus into the form of larger ſtones; which being warmed by a perſon's hand, and rubbed upon paper, would deſcribe letters that were very legible in the dark.

The greateſt variety of experiments with the light of phoſphorus was made by Dr Slare; who ſays, that the liquid phoſphorus (which is nothing more than the ſolid phoſphorus diſſolved in any of the eſſential oils) would not hurt even a lady's hand; or that, when the hands or face were waſhed with it, it would not only make them viſible to other perſons in the dark, but that the light was ſo conſiderable as to make other neighbouring objects viſible.

When the ſolid phoſphorus is quite immerſed in water, he obſerves that it ceaſes to ſhine; but that if any part of it chance to emerge, or get into the air, it will ſhine though the glaſs be hermetically ſealed. In a large glaſs he kept it without water for ſeveral days; and yet it continued ſhining, with very little diminution of its light or weight. If the letters that were written with this phoſphorus were warmed by the fire, they preſently became dark lines, which continued upon the paper, like ink. To try how much light was given by a ſmall quantity of this phoſphorus, he obſerved that it continued to flame in the open air for ſeven or eight days; the light being viſible whenever he ſhut his window.

As air was generally thought to contain the *pabulum* of flame, Dr Slare was determined to try this with reſpect to phoſphorus; and for this purpoſe he placed a large piece of it in a receiver; but upon exhauſting it, be perceived that it became more luminous, and that, upon admitting the air, it returned to its former ſtate. This property of the light of phoſphorus, which is the very reverſe of that of ſhining wood and fiſhes, was alſo aſcertained by ſeveral very accurate experiments of Mr Hauksbee's.

Endeavouring to blow the phoſphorus into a flame with a pair of bellows, Dr Slare found that it was preſently blown out, and that it was a conſiderable time before the light revived again. All liquors would extinguiſh this light when the phoſphorus was put into them; nor would it ſhine or burn, though it was even boiled in the moſt inflammable liquors, as oil of olives, ſpirit of turpentine, or even ſpirit of wine.

In order to keep his phoſphorus from conſuming, he uſed to put it in a glaſs of water; and ſometimes he has ſeen it, when thus immerſed in water, make ſuch bright and vigorous coruſcations in the air, as, he ſays, would ſurpriſe and frighten thoſe who are not uſed to the phenomenon. This fiery meteor, he ſays, is contracted in its paſſage through the water, but expands as ſoon as it gets above it. If any perſon would make this experiment to advantage, he informs them that the glaſs muſt be deep and cylindrical, and not above three quarters filled with water. This effect he perceived in warm weather only, and never in cold.

The phoſphorus of which we have been treating is prepared from urine; but in ſome caſes the ſweat, which is ſimilar to urine, has been obſerved to be phoſphoraceous, without any preparation. This once happened to a perſon who uſed to eat great quantities of ſalt, and who was a little ſubject to the gout, after ſweating with violent exerciſe. Stripping himſelf in the dark, his ſhirt ſeemed to be all on fire, which ſurpriſed him very much. Upon examination, red ſpots were found upon his ſhirt; and the phyſician who was preſent perceived an urinous ſmell, though it had nothing in it of volatile alkali, but of the muriatic acid: the ſame, he ſays, that iſſues from cabbage much ſalted, and ſtrongly fermented.

Acta Cæſarienſa, vol. v. p. 334.

All theſe lights accounted for from electricity.

The eaſieſt method of accounting for all theſe kinds of lights, perhaps, is from electricity. If light conſiſts in a certain vibration of the electric fluid *, then it follows, that in whatever ſubſtances ſuch a vibration takes place, there light muſt appear, whether in putreſcent animal ſubſtances, ſea water, phoſphorus, or any thing elſe. We know that the electric matter pervades all terreſtrial

* See *Electricity*.

terreſtrial ſubſtances, and is very liable to be ſet in motion from cauſes of which we are ignorant. The action of the air by which putrefaction is produced may be one of theſe cauſes; and it can by no means appear ſurpriſing that the electric matter ſhould act in the bodies of living animals in ſuch a manner as to produce a permanent light, when we certainly know it acts in ſome of them ſo powerfully as to produce a ſhock ſimilar to that of a charged phial.——On this ſubject we ſhall only obſerve farther, that when this vibration becomes ſo powerful as to penetrate the ſolid ſubſtance of the body itſelf, the luminous body then becomes tranſparent, as in the milk mentioned in the former part of this article; but when it is only ſuperficial, the body, though it emits light, is itſelf opaque.

Light from Diamonds. Among luminous bodies the diamond is to be reckoned; as ſome diamonds are known to ſhine in the dark. But on account of the feebleneſs of their ſplendour, it is neceſſary for the perſon who is to obſerve them, previouſly to ſtay in the dark at leaſt a quarter of an hour; that the pupil of the eye may be dilated and enlarged, and ſo rendered capable of receiving a large quantity of the rays of light. M. du Fay has alſo obſerved, that the eyes ought to be ſhut for this time, or at leaſt one of them; and that, in that caſe, the light of the diamond is afterwards only ſeen by that eye which has been ſhut. Before the diamond is brought into the dark room, it muſt be expoſed to the ſunſhine, or at leaſt to the open daylight, to imbibe a ſufficient quantity of rays; and this is done in one minute, or even leſs; eight or ten ſeconds having been found to furniſh as much light as a ſtone is capable of receiving: and when brought into the dark, its light continues about twelve or thirteen minutes, weakening all the while, by inſenſible degrees. It is very remarkable, that in bodies ſo extremely ſimilar to each other as diamonds are, ſome ſhould have this property of imbibing the ſun's rays, and ſhining in the dark, and that others ſhould not; yet ſo it is found to be by experiment, and the moſt nearly reſembling ſtones ſhall be found one to have this property, and another to be deſtitute of it; while many of the moſt diſſimilar have the property in common. There ſeems to be no rule, nor even the leaſt traces of any imperfect rule of judging, which diamonds have, and which have not this property; their natural brightneſs, their purity, their ſize, or their ſhape, contribute nothing to it: and all that has been yet diſcovered of the leaſt regularity among them, is, that all yellow diamonds have this property. This is ſuppoſed to ariſe from their having more ſulphur in their compoſition, and therefore illuminating more readily, or emitting a more viſible flame.

The burning of diamonds is a term uſed among the jewellers, for putting them into a fierce fire, as they frequently do, when they are fouled with brown, or yellow, or the like; this always diveſts them of their colour, without doing them the leaſt ſenſible injury. M. du Fay, having been informed of this common practice, formed a conjecture, that the difference of diamonds in their ſhining or not ſhining in the dark, was owing to it; and that either all thoſe which had been burnt, or all thoſe which had not, were thoſe which alone ſhone in the dark. But this was found an erroneous conjecture; for two diamonds, one lucid in the dark, the other not, were both burnt, and afterwards both were found to retain the ſame properties they had before. It is not only the open ſunſhine, or open daylight, which gives to theſe diamonds the power of ſhining in the dark; they receive it in the ſame manner even if laid under a glaſs, or plunged in water or in milk.

M. du Fay tried whether it was poſſible to make the diamond retain, for any longer time, the light it naturally parts with ſo ſoon: and found, that if the diamond, after being expoſed to the light, be covered with black wax, it will ſhine in the dark, as well ſix hours afterwards as at the time it was firſt impregnated with the light.

The imbibing light, in this manner, being ſo nice a property as not to be found in ſeveral diamonds, it was not to be ſuppoſed that it would be found in any other ſtones: accordingly, on trial, the ruby, the ſapphire, and the topaz, were found wholly deſtitute of it; and among a large number of rough emeralds, one only was found to poſſeſs it. Such is the ſtrange uncertainty of theſe accidents.

All the other leſs precious ſtones were tried, and found not to poſſeſs this property of imbibing light from the daylight or ſunſhine, but they all became luminous by the different means of heating or friction: with this difference, that ſome acquired it by one of theſe methods, and others by the other; each being unaffected by that which gave the property to the other. The diamond becomes luminous by all theſe ways.

Beccarius alſo diſcovered, that diamonds have the property of the Bolognian phoſphorus, about the ſame time that it occurred to M. du Fay. *Com. Bonon.* vol. ii. p. 276. M. du Fay likewiſe obſerved, that the common topaz, when calcined, had all the properties of this phoſphorus; and purſuing the diſcovery, he found the ſame property, in a great degree, in the belemnites, gypſum, limeſtone, and marble: though he was obliged to diſſolve ſome very hard ſubſtances of this kind in acids, before calcination could produce this change in them; and with ſome ſubſtances he could not ſucceed even thus; eſpecially with flint ſtones, river ſand, jaſpers, agates, and rock cryſtal.

Light from Plants. In Sweden a very curious phenomenon has been obſerved on certain flowers by M. Haggern, lecturer in natural hiſtory. One evening he perceived a faint flaſh of light repeatedly dart from a marigold. Surpriſed at ſuch an uncommon appearance, he reſolved to examine it with attention; and, to be aſſured it was no deception of the eye, he placed a man near him, with orders to make a ſignal at the moment when he obſerved the light. They both ſaw it conſtantly at the ſame moment.

The light was moſt brilliant on marigolds of an orange or flame colour; but ſcarcely viſible on pale ones.

The flaſh was frequently ſeen on the ſame flower two or three times in quick ſucceſſion, but more commonly at intervals of ſeveral minutes: and when ſeveral flowers in the ſame place emitted their light together, it could be obſerved at a conſiderable diſtance.

This phenomenon was remarked in the months of July and Auguſt at ſunſet, and for half an hour, when the atmoſphere was clear; but after a rainy day, or

Light, Light-House.

when the air was loaded with vapours, nothing of it was seen.

The following flowers emitted flashes, more or less vivid, in this order:

1. The marigold, *calendula officinalis.*
2. Monk's-hood, *tropæolum majus.*
3. The orange lily, *lilium bulbiferum.*
4. The Indian pink, *tagetes patula et erecta.*

To discover whether some little insects or phosphoric worms might not be the cause of it, the flowers were carefully examined, even with a microscope, without any such thing being found.

From the rapidity of the flash, and other circumstances, it may be conjectured that there is something of electricity in this phenomenon. It is well known, that when the pistil of a flower is impregnated, the pollen bursts away by its elasticity, with which electricity may be combined. But M. Haggern, after having observed the flash from the orange lily, the antheræ of which are a considerable space distant from the petals, found that the light proceeded from the petals only; whence he concludes, that this electric light is caused by the pollen, which, in flying off, is scattered on the petals. Whatever be the cause, the effect is singular and highly curious.

LIGHTS, in *Painting*, are those parts of a piece which are illuminated, or that lie open to the luminary by which the piece is supposed to be enlightened; and which, for this reason, are painted in bright vivid colours.

In this sense, light is opposed to shadow.

Different lights have very different effects on a picture, and occasion a difference in the management of every part. A great deal therefore depends on the painter's choosing a proper light for his piece to be illuminated by; and a great deal more, in the conduct of the lights and shadows, when the luminary is pitched upon.

The strength and relievo of a figure, as well as its gracefulness, depend entirely on the management of the lights, and the joining of those to the shadows.

The light a figure receives is either direct or reflected; to each of which special regard must be had. The doctrine of lights and shadows makes that part of painting called *clair-obscure.*

Light-Horse, an ancient term in our English customs, signifying an ordinary cavalier or horseman lightly armed, and so as to enter a corps or regiment; in opposition to the men at arms, who were heavily accoutred, and armed at all points. See *Light-Horse.*

Light-House, a building erected upon a cape or promontory on the sea coast, or upon some rock in the sea, and having on its top in the night-time a great fire, or light formed by candles, which is constantly attended by some careful person, so as to be seen at a great distance from the land. It is used to direct the shipping on the coast, that might otherwise run ashore, or steer an improper course, when the darkness of the night and the uncertainty of currents, &c. might render their situation with regard to the shore extremely doubtful. Lamp-lights are, on many accounts, preferable to coal fires or candles; and the effect of these may be increased by placing them either behind glass hemispheres, or before properly disposed glass or metal reflectors, which last method is now very generally adopted. See BEACONS.

Light-Room ‖ Lightfoot.

Light-Room, a small apartment, enclosed with glass windows, near the magazine of a ship of war. It is used to contain the lights by which the gunner and his assistants are enabled to fill cartridges with powder to be ready for action.

LIGHTER, a large, open, flat-bottomed vessel, generally managed with oars, and employed to carry goods to or from a ship when she is to be laden or delivered.—There are also some lighters furnished with a deck throughout their whole length, in order to contain those merchandises which would be damaged by rainy weather: these are usually called *close lighters.*

LIGHTFOOT, JOHN, a most learned English divine, was the son of a divine, and born in March 1602, at Stoke upon Trent in Staffordshire. After having finished his studies at a school on Morton-green near Congleton in Cheshire, he was removed in 1617 to Cambridge, where he applied himself to eloquence, and succeeded so well in it as to be thought the best orator of the under graduates in the university. He also made an extraordinary proficiency in the Latin and Greek; but neglected the Hebrew, and even lost that knowledge he brought of it from school. His taste for the oriental languages was not yet excited; and as for logic, the study of it as managed at that time among the academics, was too quarrelsome and fierce for his quiet and meek disposition. As soon as he had taken the degree of B. A. he left the university, and became assistant to a school at Repton in Derbyshire. After he had supplied this place a year or two, he entered into orders, and became curate of Norton under Hales in Shropshire. This curacy gave an occasion of awakening his genius for the Hebrew tongue. Norton lies near Bellaport, then the seat of Sir Rowland Cotton; who was his constant hearer, made him his chaplain, and took him into his house. This gentleman being a perfect master of the Hebrew language, engaged Lightfoot in that study; who, by conversing with his patron, soon became sensible that without that knowledge it was impossible to attain an accurate understanding of the scriptures. He therefore applied himself to it with extraordinary vigour, and in a little time made a great progress in it: and his patron removing with his family to reside in London, at the request of Sir Alland Cotton his uncle, who was lord-mayor of that city, he followed his preceptor thither. But he did not stay long there: for, having a mind to improve himself by travelling abroad, he went down into Staffordshire to take leave of his father and mother. Passing through Stone in that county, he found the place destitute of a minister: and the pressing instances of the parishioners prevailed upon him to undertake that cure. Hereupon, laying aside his design of travelling abroad, he began to turn his thoughts upon settling at home. During his residence at Bellaport, he had fallen into the acquaintance of a gentlewoman who was daughter of William Crompton of Stonepark, Esq. and now, being in possession of that living, he married her in 1628. But notwithstanding this settlement, his unquenchable thirst after rabbinical learning would not suffer him to continue there. Sion-college library at London, he knew, Lightfoot. was well stocked with books of that kind. He therefore quitted his charge at Stone, and removed with his family to Hornsey, near the city; where he gave the public a notable specimen of his advancement in those studies, by his "Erubhim, or Miscellanies Christian and Judaical," in 1629. He was at this time only 27 years of age; and appears to have been well acquainted with the Latin and the Greek fathers, as well as the ancient heathen writers. These first fruits of his studies were dedicated to Sir Rowland Cotton; who, in 1631, presented him to the rectory of Ashley in Staffordshire.

He seemed now to be fixed for life: Accordingly, he built a study in the garden, to be out of the noise of the house; and applied himself with indefatigable diligence in searching the scriptures. Thus employed, the days passed very agreeably; and he continued quiet and unmolested, till the great change which happened in the public affairs brought him into a share of the administration relating to the church; for he was nominated a member of the memorable assembly of divines for settling a new form of ecclesiastical polity. This appointment was purely the effect of his distinguished merit; and he accepted it purely with a view to serve his country, as far as lay in his power. The non-residence, which this would necessarily occasion, apparently induced him to resign his rectory: and having obtained the presentation for a younger brother, he set out for London in 1642. He had now satisfied himself in clearing up many of the abstrusest passages in the Bible, and therein had provided the chief materials, as well as formed the plan, of his "Harmony;" and an opportunity of inspecting it at the press was, no doubt, an additional motive for his going to the capital: where he had not been long before he was chosen minister of St Bartholomew's, behind the Royal Exchange. The assembly of divines meeting in 1643, our author gave his attendance diligently there, and made a distinguished figure in their debates; where he used great freedom, and gave signal proofs of his courage as well as learning, in opposing many of those tenets which the divines were endeavouring to establish. His learning recommended him to the parliament, whose visitors, having ejected Dr William Spurstow from the mastership of Catharine-hall in Cambridge, put Lightfoot in his room, this year 1653; and he was also presented to the living of Much-Munden in Hertfordshire, void by the death of Dr Samuel Ward, Margaret-professor of divinity in that university, before the expiration of this year. Meanwhile he had his turn with other favourites in preaching before the house of commons, most of which sermons were printed; and in them we see him warmly pressing the speedy settlement of the church in the Presbyterian form, which he cordially believed to be according to the pattern in the Mount. He was all the while employed in preparing and publishing the several branches of his Harmony; all which were so many excellent specimens of the usefulness of human learning to true religion: and he met with great difficulties and discouragements in that work, chiefly from that antieruditional spirit which prevailed, and even threatened the destruction of the universities. In 1655 he entered upon the office of vice-chancellor of Cambridge, to which he was chosen that year, having taken the degree of doctor of divinity in 1652. He performed all the regular exercises for his degree with great applause, and executed the vice-chancellor's office with exemplary diligence and fidelity; and, particularly at the commencement, supplied the place of professor of divinity, then undisposed of, as an act which was kept for a doctor's degree in that profession. At the same time he was engaged with others in perfecting the Polyglott Bible, then in the press. At the Restoration he offered to resign the mastership of Catharine-hall: But, as what he had done had been rather in compliance with the necessity of the times than from any zeal or spirit of opposition to the king and government, a confirmation was granted him from the crown, both of the place and of his living. Soon after this he was appointed one of the assistants at the conference upon the liturgy, which was held in the beginning of 1661, but attended only once or twice; probably disgusted at the heat with which that conference was managed. However, he stuck close to his design of perfecting his Harmony: and being of a strong and healthy constitution, which was assisted by an exact temperance, he prosecuted his studies with unabated vigour to the last, and continued to publish, notwithstanding the many difficulties he met with from the expence of it. However, not long before he died, some booksellers got a promise from him to collect and methodise his works, in order to print them; but the execution was prevented by his death, which happened Dec. 6. 1675. The doctor was twice married: his first wife, already mentioned, brought him four sons and two daughters. His second wife was likewise a widow, and relict of Mr Austin Brograve, uncle of Sir Thomas Brograve, Bart of Hertfordshire, a gentleman well versed in rabbinical learning, and a particular acquaintance of our author. He had no issue by her. She also died before him, and was buried in Munden church; where the doctor was himself likewise interred near both his wives. Dr Lightfoot's works were collected and published first in 1684, in two volumes folio. The second edition was printed at Amsterdam, 1686, in two volumes folio, containing all his Latin writings, with a Latin translation of those which he wrote in English. At the end of both these editions there is a list of such pieces as he left unfinished. It is the chief of these, in Latin, which make up the third volume, added to the former two, in a third edition of his works, by John Leusden, at Utrecht, in 1699, folio. They were communicated by Mr Strype, who, in 1700, published anorher collection of these papers, under the title of "Some genuine remains of the late pious and learned Dr John Lightfoot."

Lighting.

LIGHTING OF STREETS. This invention, which is generally considered as of modern date, contributes greatly to the convenience and safety of the inhabitants of large cities, as well as to the ornament of their streets. It is not probable that the streets of ancient Rome were lighted, since the Romans considered the use of flambeaux and lanterns to be so necessary in returning home from their nocturnal visits. It appears that such as walked the streets without these went home in darkness; and the return of Gito in the night-time, of which Petronius makes mention, clearly proves that the streets of Naples were not lighted. Such as have ascribed a remote antiquity to the lighting of streets, seem

seem to have miftaken it for what are called illuminations, which indeed are of great antiquity. Egyptians, Jews, Greeks, and Romans, during the celebration of memorable feftivals, were in the habit of illuminating their houfes; but this is entirely different from the practice which we are now confidering.

Paris was probably the firft city in modern times, the ftreets of which were lighted, about the beginning of the 16th century, as they were very much infefted by robbers and incendiaries. This occafioned an edict, iffued in 1524, commanding the inhabitants, whofe windows fronted the ftreet, to keep lights burning after nine o'clock at night. In 1558, *falots* were placed at the corners of the ftreets; but when thefe were too long to receive benefit from the light of one, three were erected in different parts of it. The city of Paris had then 912 ftreets, and the number of lights rather under 2736; but in the fame year thefe were changed for lanterns, of a fimilar conftruction with thofe ufed at prefent.

In 1671, the lanterns were ordered to be lighted every year from the 20th October to the end of March the enfuing year. Some time after this a premium was offered for a differtation on the beft means of improving the lighting of the ftreets, when a journeyman glazier obtained a premium of 200 livres, and Meffrs Bailly, le Roy, and Bourgeois de Chateaublanc, 2000 livres. The lamps of Paris amounted to 5772 in the year 1721, and in 1771, to 6232. The city of Nantz was lighted in 1777, and had no fewer than 500 lamps in the year 1780.

The inhabitants of the city of London were ordered, in 1688, to hang out lanterns duly at the accuftomed time, which was renewed in 1690; and in 1716 it was enacted, that all thofe whofe houfes fronted any ftreet, lane, or public paffage, fhould hang out one or more lights, which were to burn from 6 o'clock to 11. But as the time of lighting them was reftricted to 117 nights in the year, on which account many depredations were eafily committed by thieves and robbers, the lord mayor and council applied for, and obtained an act of parliament, empowering them to light the ftreets in a better manner. In confequence of this act, the lamps were increafed from 1000 to 4769, and afterwards to 5000. But as thefe were confined to the city and liberties, about one-fifth of the whole of London, the number of lamps could not be lefs than 15,000. The continuance of their burning was alfo increafed from 750 to 5000 hours. In 1744, another act was obtained to regulate ftill farther the lighting of the city, and it was placed on the footing on which it ftands at prefent. Thefe are now fo numerous, that Oxford ftreet alone is faid to contain more lamps than the whole city of Paris. Birmingham was lighted for the firft time in 1733, with 700 lamps.

In 1669, Amfterdam was lighted by lanterns; the Hague in 1553 was lighted in a particular manner, but lamps were not fixed up in all the ftreets till the year 1678. The ftreets of Copenhagen were lighted in 1681, the plan of which was much improved in 1683. Berlin at prefent has 2354 lamps, kept lighted from September to May at the expence of the fovereign. Vienna began to be lighted in 1687, and lamps were introduced in 1704. In 1776 their number amounted to 2000, which was increafed to 3000, to be lighted at the annual expence of 30,000 florins. Leipzig was lighted in 1702, Drefden in 1705, Caffel in 1721, and Gottingen in 1735. A practice fo beneficial to the fafety and convenience of mankind, has been very laudably imitated by almoft every city and town in Europe. *Beckman Hift. of Invent.*

LIGHTNING, a bright and vivid flafh of fire, fuddenly appearing in the atmofphere, and commonly difappearing in an inftant, fometimes attended with clouds and thunder, and fometimes not. For an account of the phenomena of lightning, and of the opinions concerning it, fee ELECTRICITY *Index*.

Artificial LIGHTNING. Before the difcoveries of Dr Franklin concerning the identity of electricity and lightning, many contrivances were invented in order to reprefent this terrifying phenomenon in miniature: the corufcations of phofphorus in warm weather, the accenfion of the vapour of fpirit of wine evaporated in a clofe place, &c. were ufed in order to fupport the hypothesis which at that time prevailed; namely, that lightning was formed of fome fulphureous, nitrous, or other combuftible vapours, floating in long trains in the atmofphere, which by fome unaccountable means took fire, and produced all the deftructive effects of that phenomenon. Thefe reprefentations, however, are now no more exhibited; and the only true artificial lightning is univerfally acknowledged to be the difcharge of electric matter from bodies in which it is artificially fet in motion by machines.

LIGHTNING was looked upon as facred both by the Greeks and Romans, and was fuppofed to be fent to execute vengeance on the earth: Hence perfons killed with lightning, being thought hateful to the gods, were buried apart by themfelves, left the afhes of other men fhould receive pollution from them. Some fay they were interred upon the very fpot where they died; others will have it that they had no interment, but were fuffered to rot where they fell, becaufe it was unlawful for any man to approach the place. For this reafon the ground was hedged in, left any perfon unawares fhould contract pollution from it. All places ftruck with lightning were carefully avoided and fenced round, out of an opinion that Jupiter had either taken offence at them, and fixed upon them the marks of his difpleafure, or that he had, by this means, pitched upon them as facred to himfelf. The ground thus fenced about was called by the Romans *bidentul*. Lightning was much obferved in augury, and was a good or bad omen, according to the circumftances attending it.

LIGNICENCIS TERRA, in the *Materia Medica*, the name of a fine yellow bole found in many parts of Germany, particularly about Emeric in the circle of Weftphalia, and ufed as an aftringent.

LIGNUM VITÆ. See GUAIACUM, BOTANY and MATERIA MEDICA *Index*.

LIGNUM *Aloes*. See EXCOECARIA, BOTANY *Index*.

LIGNUM *Nephriticum*. See GUILANDINA, BOTANY *Index*.

LIGNUM *Rhodium*, or *Rofewood*, in the *Materia Medica*; a wood, or root, chiefly brought from the Canary iflands.

The tafte of this wood is lightly bitterifh, and fomewhat pungent; its fmell is very fragrant, refembling that

that of roses: long kept, it seems to lose its smell; but on cutting, or rubbing one piece against the other, it smells as well as at first. Distilled with water, it yields an odoriferous essential oil, in very small quantity. Rhodium is at present in esteem only upon account of its oil, which is employed as a high and agreeable perfume.

Lignum Campechense. See HEMATOXYLUM, BOTANY *Index*.

Lignum Colubrinum. See OPHIORHIZA.

LIGULATED, among botanists, an appellation given to such floscules as have a straight end turned downwards, with three indentures, but not separated into segments.

LIGURIA, in *Ancient Geography*, a country of Italy, bounded on the south by the Mediterranean sea, on the north by the Apennine mountains, on the west by part of Transalpine Gaul, and on the east by Etruria. There is a great disagreement among authors concerning the origin of the Ligurians, though most probably they were descended from the Gauls. Some carry up their origin as far as the fabulous heroes of antiquity; while others trace them from the Ligyes, a people mentioned by Herodotus as attending Xerxes in his expeditions against Greece. These Ligyes are by some ancient geographers placed in Colchis; by others, in Albania.—According to Diodorus Siculus, the Ligurians led a very wretched life; their country being entirely overgrown with woods, which they were obliged to pull up by the root, in order to cultivate their land, which was also encumbered with great stones, and, being naturally barren, made but very poor returns for all their labour. They were much addicted to hunting; and, by a life of continual exercise and labour, became so strong, that the weakest Ligurian was generally an overmatch for the strongest and most robust among the Gauls. The women are said to have been almost as strong as the men, and to have borne an equal share in all laborious enterprises. With all their bravery, however, they were not able to resist the Roman power; but were subdued by that warlike nation, about 211 B. C.

LIGUSTICUM, LOVAGE; a genus of plants belonging to the pentandria class; and in the natural method ranking under the 45th order, *Umbellatæ*. See BOTANY *Index*.

LIGUSTRUM, PRIVET; a genus of plants belonging to the diandria class; and in the natural method ranking under the 44th order, *Sepiariæ*. See BOTANY *Index*.

LILBURNE, JOHN, an enthusiastic demagogue, who was tyrannically punished by the star-chamber court, being put in the pillory, whipped, fined, and imprisoned, for importing and publishing seditious pamphlets, which he had got printed in Holland; they chiefly reflected on the church of England and its bishops: he suffered in 1637, and in prison was doubly loaded with irons. In 1641, he was released by the long parliament: and from this time he had the address to make himself formidable to all parties, by his bold, aspiring genius. He signalized himself in the parliament army; and was at one time the secret friend and confidant of Cromwell, and at another his avowed enemy and accuser; so that, in 1650, Cromwell found it to be his interest to silence him, by a grant of some forfeited estates. But after this, he grew outrageous against the protector's government; became chief of the levellers; and was twice tried for high treason, but acquitted by the juries. The last was for returning from exile (having been banished by the parliament) without a pass. He died in 1657, aged 88.

LILIACEOUS, in *Botany*, an appellation given to such flowers as resemble those of the lily.

LILIUM, the LILY; a genus of plants belonging to the hexandria class, and in the natural method ranking under the 10th order, *Coronariæ*. See BOTANY *Index*.

LILLO, GEORGE, an excellent dramatic writer, was born at London in 1693. He was a jeweller by profession, and followed his business for many years in that neighbourhood with the fairest reputation. He was at the same time strongly attached to the muses, yet seemed to have laid it down as a maxim, that the devotion paid to them ought always to tend to the promotion of virtue, morality, and religion. In pursuance of this aim, Lilly was happy in the choice of his subjects, and showed great power of affecting the heart, by working up the passions to such a height as to render the distresses of common and domestic life equally interesting to the audiences as that of kings and heroes, and the ruin brought on private families by an indulgence of avarice, lust, &c. as the havock made in states and empires by ambition, cruelty, or tyranny. His "George Barnwell," "Fatal Curiosity," and "Arden of Feversham," are all planned on common and well known stories; yet they have perhaps more frequently drawn tears from an audience than the more pompous tragedies of Alexander the Great, All for Love, &c. In the prologue to "Elmeric," which was not acted till after the author's death, it is said, that when he wrote that play, he "was depressed by want," and afflicted by disease; but in the former particular there appears to be evidently a mistake, as he died possessed of an estate of 60l. a-year, besides other effects to a considerable value. His death happened in 1739, in the 47th year of his age. His works have been collected, and published, with an account of his life, in 2 vols 12mo.

LILLY, JOHN, a dramatic poet, was born in the Wealds of Kent, about the year 1553, and educated in Magdalen-college, Oxford, where he took the degree of bachelor of arts in 1573, and that of master in 1575. From Oxford he removed to Cambridge; but how long he continued there, is uncertain. On his arrival in London, he became acquainted with some of Queen Elizabeth's courtiers, by whom he was caressed, and admired as a poet and a wit; and her majesty, on particular festivals, honoured his dramatic pieces with her presence. His plays are nine in number. His first publication, however, printed in 1580, was a romance called *Euphues*, which was universally read and admired. This romance, which Blount, the editor of six of his plays, says introduced a new language, especially among the ladies, is, according to Berkenhout, in fact a most contemptible piece of affectation and nonsense: nevertheless it seems very certain, that it was in high estimation by the women of fashion of those times, who, we are told by Whalley, the editor of Ben Johnson's works, had all the phrases by heart; and

Lilly.

and those who did not speak *Euphuism* were as little regarded at court as if they could not speak French. "He was (says Oldys) a man of great reading, good memory, ready faculty of application, and uncommon eloquence; but he ran into a vast excess of allusion." When or where he died is not known. Anthony Wood says he was living in 1597, when his last comedy was published. After attending the court of Queen Elizabeth 13 years, notwithstanding his reputation as an author, he was under a necessity of petitioning the queen for some small stipend to support him in his old age. His two letters or petitions to her majesty on this subject are preserved in manuscript.

Lilly, *William*, a noted English astrologer, born in Leicestershire in 1602; where his father not being able to give him more learning than common writing and arithmetic, he resolved to seek his fortune in London. He arrived in 1620, and lived four years as a servant to a mantua-maker in the parish of St Clements Danes; but then moved a step higher to the service of Mr Wright, master of the Salters company in the Strand, who not being able to write, Lilly among other offices kept his books. In 1627, when his master died, he paid his addresses to the widow, whom he married with a fortune of 1000l. Being now his own master, he followed the puritanical preachers; and, turning his mind to judicial astrology, became pupil to one Evans, a profligate Welsh parson, in that pretended art. Getting a MS. of the *Ars Notitia* of Corn. Agrippa, with alterations, he drank in the doctrine of the magic circle, and the invocation of spirits, with great eagerness. He was the author of the *Merlinus Anglicus junior;* The Supernatural Sight; and The White King's Prophecy. In him we have an instance of the general superstition and ignorance that prevailed in the time of the civil war between Cha. I. and his parliament: for the king consulted this astrologer to know in what quarter he should conceal himself, if he could escape from Hampton court; and General Fairfax, on the other side, sent for him to his army, to ask him if he could tell by his art, whether God was with them and their cause? Lilly, who made his fortune by favourable predictions to both parties, assured the general that God would be with him and his army. In 1648, he published his Treatise of the Three Suns seen the preceding winter; and also an astrological judgement upon a conjunction of Saturn and Mars. This year the council of state gave him in money 50l. and a pension of 100l. per annum, which he received for two years, and then resigned on some disgust. In June 1660, he was taken into custody by order of the parliament, by whom he was examined concerning the person who cut off the head of King Charles I. The same year he sued out his pardon under the great seal of England. The plague raging in London, he removed with his family to his estate at Hersham; and in October 1666 was examined before a committee of the house of commons concerning the fire of London, which happened in September that year. After his retirement to Hersham, he applied himself to the study of physic, and, by means of his friend Mr Ashmole, obtained from Archbishop Sheldon a license for the practice of it. A little before his death he adopted for his son, by the name of *Merlin junior*, one Henry Coley, a taylor by trade; and at the same time gave him the impression of his almanack, after it had been printed for 36 years. He died in 1681 of a dead palsy. Mr Ashmole set a monument over his grave in the church of Walton upon Thames. His "Observations on the Life and Death of Charles late King of England," if we overlook the astrological nonsense, may be read with as much satisfaction as more celebrated histories; Lilly being not only very well informed, but strictly impartial. This work, with the Lives of Lilly and Ashmole, written by themselves, were published in one vol. 8vo, in 1774, by Mr Burman.

Lily || Lima.

LILY. See Lilium, Botany *Index*.

Lily of the Valley. See Convallaria, Botany *Index*.

LILYBÆUM, in *Ancient Geography*, a city of Sicily, situated on the most westerly promontory of the island of Sicily, and said to have been founded by the Carthaginians on their expulsion from Motya by Dionysius tyrant of Syracuse. It is remarkable for three sieges it sustained; one against Dionysius the tyrant, another against Pyrrhus king of Epirus, and the third against the Romans. The two first failed in their attempts, but the Romans with great difficulty made themselves masters of it. No remains of this once stately city are now to be seen, except some aqueducts and temples; though it was standing in Strabo's time.

LILYE, William, the grammarian, was born in the year 1466 at Oldham in Hampshire; and in 1486 was admitted a semi-commoner of Magdalen college in Oxford. Having taken the degree of bachelor of arts, he left the university, and travelled to Jerusalem. Returning from thence, he continued five years in the island of Rhodes, where he studied the Greek language, several learned men having retired thither after the taking of Constantinople. From Rhodes he travelled to Rome; where he improved himself in the Greek and Latin languages, under Sulpitius and P. Sabinus. He then returned to London, where for some time he taught a private grammar-school, being the first person who taught Greek in the metropolis. In 1510, when Dr Colet founded St Paul's school, Lilye was appointed the first master; at which time, it seems, he was married and had many children. In this employment he had laboured 12 years, when, being seized by the plague, which then raged in London, he died in February 1523, and was buried in the north yard of St Paul's. He had the character of an excellent grammarian, and a successful teacher of the learned languages. His principal work is *Brevissima institutio, seu ratio grammatices cognoscendæ*; Lond. 1513. Reprinted times without number, and commonly called *Lilye's grammar*. The English rudiments were written by Dr Colet, dean of St Paul's; and the preface to the first edition, by Cardinal Wolsey. The English syntax was written by Lilye; also the rules for the genders of nouns, beginning with *propria quæ maribus:* and those for the preterperfect tenses and supines, beginning with *As in presenti.* The Latin syntax was chiefly the work of Erasmus. See Ward's preface to his edition of Lilye's Grammar, 1732.

LIMA, the metropolis of Peru, contains 209 squares of buildings, which comprise 8222 doors of dwelling houses and shops, and these are branched out into 355 streets. In order to maintain peace and tranquillity among the

Lima.

the inhabitants, and for the accommodation of the police, the city is divided into four quarters, containing 35 diſtricts, over each of which there preſides an alcaid, who is always elected from among the people of the moſt diſtinguiſhed rank. The population, according to eſtimates made at different periods, is as follows.

In 1600,	-	14,262
1614,	-	25,455
1700,	-	37,259
1746,	-	60,000
1755,	-	54,000
1781,	-	60,000
1790,	-	52,627

By this table it appears, that from 1746 to 1755, the population ſuffered a diminution of 6000, which was owing to an earthquake that happened at the former period ;—a calamity with which that city is often viſited. Were it not for this circumſtance, Lima would be a perfect paradiſe, as the adjacent country abounds with corn, wine, oil, ſugar, fruits and flax. Such abundance of wealth do the inhabitants enjoy, that when the duke of Palata was ſent from Spain as viceroy to Peru, they paved the ſtreets through which he was to paſs with ingots of ſilver. Libertiniſm and debauchery are the diſtinguiſhing characteriſtics of the people of Lima, for which even the nuns are as notorious as the reſt of the females, ſeldom being free from venereal complaints.

In the month of March 1543, the emperor Charles V. eſtabliſhed an audience at Lima, in conſequence of which the inhabitants were freed from the painful neceſſity of ſeeking a redreſs of their grievances at ſo great a diſtance as Panama. Among the excellent inſtitutions by which the Peruvian capital is diſtinguiſhed we may rank the provincial councils, which ſhew the conſtant zeal of the ſovereigns of Spain for the defence of religion and preſervation of diſcipline. The prelates, by their paſtoral vigilance, ſpare neither pains nor labour to promote their views, to accompliſh their ſacred and intereſting purpoſes.

By a decree of the Spaniſh emperor, which reached Lima in 1553, a univerſity was begun in a central ſpot of the capital, called the univerſity of St Mark, which is now in a moſt flouriſhing condition. Don Franciſco Toledo aſſigned 20,312 piaſtres as a fund for the maintenance of the profeſſors, ariſing from the tributes paid by the Indians. Two lectures are given daily on grammar, one on the Indian language, three on philoſophy, three on theology, three on law, two on canons, and two on medicine. In the year 1790 an amphitheatre was erected for the uſe of the anatomical ſtudents.

The college for female orphans was founded by Mateo Paſtor De Velaſco, not at the hour of death, which often gives to charitable endowments an air of ſuſpicion, but when he was in the full poſſeſſion of perfect health. In 1597 a pious philoſopher founded a charitable inſtitution for the ſupport of ſuch helpleſs children as were laid down in the ſtreets by their unfeeling parts. This building was deſtroyed by the earthquake of 1687, which laid in ruins the greater part of the city. It was afterwards rebuilt and is at preſent in a flouriſhing condition. In 1559 an hoſpital was erected for the relief of the unfortunate ſick, who might otherwiſe have periſhed for want of medical aid, and obtained the name of the *Fellowſhip of Charity and Compaſſion*. A general hoſpital for the poor was begun about 1758, but not completed till 1770, which in 1790 afforded a comfortable aſylum to 29 poor people. The aſylum for penitent females was founded in 1669. It has been ſaid that there is not a city in the world in which ſo many alms are diſtributed as in Lima.

Limaſſol.

In the centre of the great ſquare there is a fountain of bronze, the ornaments of which are conformable to the rules of the compoſite order. It has an elevation of 15½ yards to the helmet of Fame, from which deducting 1¼ yards for the height of that figure, the remainder gives the part to which the water riſes in order to diffuſe itſelf. This production of art, combining magnificence in every part of it with fine architectural taſte, is ſurrounded by 24 pieces of artillery, and 16 iron chains, a narrow ſpace being left for acceſs to the inhabitants.

Coffee-houſes were not known in Lima till the year 1771, when one was opened in the ſtreet of Santo Domingo, and another the year following. A third was eſtabliſhed in 1775, a fourth in 1782, and a fifth in 1788, in each of which there is a billiard table for the amuſement of the inhabitants. We are ſorry to ſay that the barbarous practice of cock-fighting obtains in Lima, for which purpoſe a building was erected in the year 1762. The tennis court is open to the public, and affords the ſpectator an agreeable hour of relaxation from more ſerious purſuits. Lima is ſituated in W. Long. 76. 44. S. Lat. 12. 1.

LIMASSOL, or LIMISSO, a town of Cyprus, in the ſouth of the iſland. Of the ancient city nothing but ruins now remains ; though it was a celebrated place, even under the government of the dukes. King Richard, the conqueror of the laſt of theſe vaſſals of the empire, razed it in 1191, and it was never afterwards rebuilt. This city originally was the ſame as AMATHUS, or Amathonte ; ſo famous, as Pauſanias tells us, for its temple erected in honour of Venus and Adonis. Amathus was the reſidence of the nine firſt kings of the iſland ; and, amongſt others of Oneliſtus, who was ſubjected afterwards by the arms of Artabanes, the Perſian general. This city, erected into an archbiſhopric in the time of the Chriſtians, has produced a number of perſonages celebrated for their knowledge and the ſanctity of their lives. In the neighbourhood there are ſeveral copper mines, which the Turks have been forced to abandon. The following lines, in the tenth book of Ovid's Metamorphoſes, prove that they were known in the time of that poet :

Mariti's Travels through Cyprus.

Capta viri forma, non jam Cytherea curat
Littora, non alto repetit Paphon æquore cinctam,
Piſcoſamque Gnidon, gravidamque Amathunta metallis.

The place where the new Limaſſol now ſtands formerly had the name of *Nemoſia*, from the multitude of woods by which it was ſurrounded. Richard king of England having deſtroyed Amathonte, Guy de Luſignan, in the 12th century, laid the foundation of that new city which the Greeks called *Neopolcos*. The family of Luſignan, who continued to embelliſh and fortify it, built there palaces, and Greek and Latin churches ; and made it the ſeat of a biſhop. When the

2

the iſland was taken by the Turks in 1570, the Ottoman army entered this city on the 2d of July, and ravaged it without mercy. It was then deſtroyed by the flames: and at preſent it is only a wretched place, in which one can ſcarcely diſtinguiſh any remains of its ancient edifices. It is governed by a commiſſary and a cadi: the latter judges caſes only proviſionally, before they are carried to the ſuperior tribunal of Nicoſia. The harbour is very commodious; and being ſheltered from impetuous winds, it affords a ſafe and calm aſylum to veſſels when overtaken by a ſtorm. The carob tree is here more abundant than anywhere elſe; and it is from the port of Limaſſol that the greateſt quantity of its fruit is exported. The inhabitants export alſo ſalt, procured from a lake near Salines. Cotton, wheat, barley, and mulberry trees, are both plentiful and well cultivated in this part of the iſland: the ground alſo produces all kinds of garden ſtuff. The beſt Cyprus wine is made from the vines that grow on the hills of Limaſſol. All the wines of the country are collected in this city to be tranſported to Larnic, where there are the largeſt cellars, and which on that account becomes the natural centre of commerce.

LIMAX, the SLUG, or *Naked Snail;* a genus of animals belonging to the claſs vermes. See HELMINTHOLOGY *Index*.

LIMB, in general, denotes the border or edge of a thing; thus we ſay, the limb of a quadrant, of the ſun, of a leaf, &c.

LIMB, in *Anatomy*, an appellation given to the extremities of the body, as to the arms and legs.

Limb, Limbus, in the church of Rome, is uſed in two different ſenſes. 1. The limb of the patriarchs is ſaid to be the place where the patriarchs waited the redemption of mankind: in this place they ſuppoſe our Saviour's ſoul continued from the time of his death to his reſurrection. 2. The limb of infants dying without baptiſm, is a place ſuppoſed to be diſtinct both from heaven and hell; ſince, ſay they, children dying innocent of any actual ſin, do not deſerve hell; and, by reaſon of their original ſin, cannot be admitted into heaven.

LIMBAT, the name of a periodical wind common in the iſland of Cyprus, and of great ſervice in moderating the heats of the climate, which would otherwiſe be intolerable.

According to the abbé Mariti, it begins to blow at eight in the morning the firſt day; increaſes as the ſun advances till noon; then gradually weakens, and at three falls entirely. On the ſecond day it ariſes at the ſame hour; but it does not attain its greateſt ſtrength till about one in the afternoon, and ceaſes at four preciſely. On the third day it begins as before; but it falls an hour later. On the five ſucceeding days, it follows the ſame progreſſion as on the third; but it is remarked, that a little before it ceaſes, it becomes extremely violent. At the expiration of five days it commences a new period like the former. By narrowly obſerving the ſea on that ſide from which it is about to blow, a little before it ariſes, one may determine what degree of ſtrength it will have during the day. If the horizon is clear, and entirely free from clouds, the wind will be weak, and even almoſt inſenſible; but if it is dark and cloudy, the wind will be ſtrong and violent. This limbat wind, notwithſtanding its utility in moderating the exceſſive heat, often becomes the cauſe of fevers, eſpecially to Europeans, from their being leſs habituated to the climate, and more apt than the natives to ſuffer themſelves to be ſurpriſed by the cool air when in a ſtate of perſpiration. This wind, the falling of which happens an hour ſooner or later, is ſucceeded by a calm, accompanied by a certain moiſture that renders the air ſomewhat heavy. This moiſture diſappears in the evening, being diſſipated by a wind which ariſes every day at that period. This wind is conſidered as a land breeze by the inhabitants of the ſouthern and eaſtern parts of the iſland; but it is called *a ſea breeze* by thoſe in the northern and weſtern, who indeed receive it immediately from the ſea. In ſummer it blows till four o'clock in the morning, and when it ceaſes, it leaves a profound calm, which continues till the hour when the limbat commences. In autumn and winter it never falls till day-break, when it is ſucceeded by other winds, which proceed from the irregularity of the ſeaſon. In ſpring it does not continue longer than midnight; and is then ſucceeded by that happy calm, during which thoſe refreſhing dews are formed that moiſten the earth at ſunriſing. The limbat winds, which ariſe in the beginning of ſummer, ceaſe about the middle of September; and this is the period when the moſt inſupportable heats commence, becauſe their violence is not moderated by the ſmalleſt breeze. They are however, luckily not of long duration; and about the latter end of October they decreaſe ſenſibly, as the atmoſphere begins to be loaded with watery clouds.

LIMBORCH, PHILIP, a learned writer among the remonſtrants, born at Amſterdam in 1633. After having made great proficiency in his ſtudies, he was, in 1655, admitted to preach in public, which he did firſt at Haerlem. His ſermons had in them no affected eloquence; but were ſolid, methodical, and edifying. He was choſen miniſter of Goudja; from whence he was called to Amſterdam, where he had the profeſſorſhip of divinity, in which he acquitted himſelf with great reputation till his death, which happened in 1712. He had an admirable genius, and a tenacious memory. He had many friends of diſtinction in foreign parts as well as in his own country. Some of his letters to Mr Locke are printed with thoſe of that celebrated author. He had all the qualifications ſuitable to the character of a ſincere divine, lived an example of every virtue, and preſerved the vigour of his body and mind to a conſiderable age. He wrote many works, which are eſteemed; the principal of which are, 1. *Amica collatio de veritate religionis Chriſtianæ cum erudito Judæo*, in 12mo. 2. A Complete Body of Divinity, according to the opinions and doctrines of the Remonſtrants. 3. A Hiſtory of the Inquiſition; which has been tranſlated into Engliſh by Dr Samuel Chandler. Limborch alſo publiſhed the works of the famous Epiſcopius, who was his great-uncle by the mother's ſide.

LIMBURGH DUCHY, a province of the Auſtrian Netherlands, bounded by the duchy of Juliers on the north and eaſt, by Luxemburgh on the ſouth, and by the biſhopric of Liege on the weſt. It is about 30 miles in length, and 25 in breadth; and conſiſts of good arable and paſture land, with plenty of wood, and ſome iron mines.

LIMBURGH, the capital city of the duchy of Limburgh,

burgh, in the Auftrian Netherlands, is feated on a fteep rock near the river Veffe. This town is fmall, but pleafantly feated on a hill, with fhady woods; and confifts chiefly of one broad ftreet, not very well built. It is ftrong by fituation, and almoft inacceffible; however, it was taken by the French in 1675, and by the confederates under the duke of Marlborough in 1703, for the houfe of Auftria, to whom it remains by the treaties of Raftadt and Baden, after having been difmantled. It is famous for its cheefe, which is exceeding good. E. Long. 6. 8. N. Lat. 50. 40.

LIME, a peculiar earth. See CHEMISTRY *Index*.

LIME-Tree. See CITRUS, BOTANY *Index*.

LIME or *LINDEN-Tree*. See TILIA, BOTANY *Index*.

LIME-Water. See PHARMACY *Index*.

LIME, or *Lyme*. See LYME.

LIMERICK, a county of Ireland, in the province of Munfter, is bounded on the eaft by Tipperary, on the weft by Kerry, on the north by the river Shannon, and on the fouth by Cork. It is a fruitful and populous tract, the foil requiring little or no manure in moft places: befides rich pafture for fheep and cows, it produces rich crops of all kinds of corn and rape, with fome hemp. It gave title of earl to the family of Donegal. It contains 375.320 Irifh plantation acres, about 56 church livings, though a much greater number of parifhes, 10 baronies, three boroughs; and formerly fent eight members to parliament. It has fome clays, furze, fern, and mountain lands, and is famous for good cyder; it has been much benefited by the Palatines, who fettled there and increafed tillage; they are a laborious independent people, moftly employed in their own farms. This county is well watered by large and fmall rivers; the Shannon runs at the north fide of the county, and fertilizes its banks. The firing of the inhabitants is chiefly turf, and the bogs are conveniently fituated. At Loghill in the weft of the county, there is a mine of coal or culm, but it is more ufed in kilns than in houfes. There are few lakes except Lough Gur; and the principal hills are Knockgreny, Knockany, Knokfiring and Toryhill. The mountains lie weftward, the higheft being Knockpatrick or St Patrick's hill. This county is about 45 miles long and 42 broad.

LIMERICK, or *Lough-Meath*, a market town, a borough, and a bifhop's fee, now the metropolis of the province of Munfter. It is fituated on the river Shannon, 94 miles from Dublin; and was the ftrongeft fortrefs in the kingdom. Its ancient name was Lunneach; and during the firft ages it was much frequented by foreign merchants, and after the arrival of the Danes was a place of confiderable commerce until the 12th century. It was plundered by Mahon, brother of Brien Boromh, after the battle of Sulchoid, in 970; and Brien, in a future period, exacted from the Danes of this city 365 tons of wine as a tribute, which fhows the extenfive traffic carried on by thofe people in that article. About the middle of the 6th century, St Munchin erected a church and founded a bifhopric here; which, however, was deftroyed by the Danes on their taking poffeffion of this port in 853, and remained in ruins until their converfion to the Chriftian faith in the 10th century; at which period the church of St Munchin was rebuilt, and the bifhopric eftablifhed. Donald O'Brien, about the time of the arrival of the Englifh, founded and endowed the cathedral; and Donat O'Brien, bifhop of Limerick, in the 13th century, contributed much to the opulence of the fee. About the clofe of the 12th century, the bifhopric of Innis-Cathay was united to that of Limerick. It was befieged by King William III. in the year 1690, and though there was no army to affift it, the king was obliged to raife the fiege. In the year 1691, it was again befieged by the Englifh and Dutch on the 21ft of September; and it was obliged to furrender on the 13th of October following, not without the lofs of abundance of men; however, the garrifon had very honourable and advantageous conditions, being permitted to retire where they thought fit, and the Roman catholics by thefe articles were to be tolerated in the free exercife of their religion. Within a century this place was reckoned the fecond city in Ireland; at prefent it has loft its rank; not becaufe it thrives lefs, but becaufe Cork thrives more. It is compofed of the Irifh and Englifh town; the latter ftands on the King's ifland, formed by the river Shannon. The town is three miles in circumference, having weekly markets on Wednefday and Saturday, and fairs on Eafter Tuefday, 1ft July, 4th Auguft, and 12th December. There is a privilege annexed to the fair held on 4th Auguft, that, during 15 days, no perfon can be arrefted in the city or liberties, on any procefs iffuing out of the tholfel court of Limerick. Ardfert and Achadoe, in the county of Kerry, are united to the bifhopric of Limeric. This city formerly returned two members to parliament; and gives title of vifcount to the family of Hamilton. It is governed by a mayor, fheriffs, recorder, aldermen, and burgeffes; there is alfo a barrack and a military governor and town major: it had fome time the privilege of coinage; and different parliaments have been held there. The town was formerly entirely walled in; and in 1760, there were 17 of the city gates ftanding; but to the great improvement of the place they are now all demolifhed, except the watergate of King John's caftle. The linen, woollen, and paper manufactures, are carried on here to great extent, and the export of provifions is very confiderable. Here are many charitable hofpitals, and handfome public buildings, befides the cathedral and other churches. A charter was granted to this city by King John, and confirmed in fucceeding reigns. Dr Campbell obferves, that as you approach Limerick, the grounds grow rich and exquifitely beautiful; the only difagreeable matter is, that the fituation renders the air moift, and confequently rather unwholefome to ftrangers. About fix miles from this is the famous Caftleconnel fpa. Limerick is 50 miles from Cork, 50 from Galway, and 73 from Waterford. It appears that Limerick obtained the privilege of having mayors 10 years before that right was allowed to the citizens of London. It was before governed by provofts, of which the firft was John Spafford in 1195 and 1197; during the provoftfhip of Henry Troy a charter was granted, 9 Richard I. whereby the citizens were allowed to choofe mayors and bailiffs, Adam Servant, in 1198, being the firft mayor. It continued to be governed by mayors and bailiffs, until the office of bailiff was changed into that of fheriff in 1609.

LIMERICK is alfo the name of a fair-town in the county of Wexford and province of Leinfter; the fairs are four in the year.

LIMINGTON, a town of Hampfhire in England. See LYMINGTON.

LIMIT, in a reftrained fenfe, is ufed by mathematicians for a determined quantity to which a variable one continually approaches; in which fenfe, the circle may be faid to be the limit of its circumfcribed and infcribed polygons. In *Algebra*, the term *limit* is applied to two quantities, one of which is greater and the other lefs than another quantity; and in this fenfe it is ufed in fpeaking of the limits of equations, whereby their folution is much facilitated.

LIMITED PROBLEM, denotes a problem that has but one folution, or fome determinate number of folutions; as to defcribe a circle through three given points that do not lie in a right line, which is limited to one folution only; to divide a parallelogram into two equal parts by a line parallel to one fide, which admits of two folutions, according as the line is parallel to the length or breadth of the parallelogram; or to divide a triangle in any ratio by a line parallel to one fide, which is limited to three folutions, as the line may be parallel to any of the three fides.

LIMME, a town of Kent, in England, near Hithe, and four miles from Romney, was formerly a port, till choked up by the fands; and though it is thereby become a poor town, yet it has the horn and mace and other tokens left of its ancient grandeur, and ufed to be the place where the lord warden of the cinque ports was fworn at his entrance upon his office. The Roman road from Canterbury, called *Stane ftreet*, ended here; and from the brow of its hill may be feen the ruinous Roman walls almoft at the bottom of the marfhes. Here formerly was a caftle, now converted into a farm-houfe. When or by whom this edifice was erected is not known. It has, however, great marks of antiquity; as has alfo the adjoining church, on which are feveral old tombftones with croffes on them.

LIMNING, the art of painting in water colours, in contradiftinction to painting which is done in oil-colours.

Limning is much the more ancient kind of painting. Till a Flemifh painter, one John van Eyck, better known by the name of *John of Bruges*, found out the art of painting in oil, the painters all painted in water and in frefco, both on their walls, on wooden boards, and elfewhere. When they made ufe of boards, they ufually glued a fine linen cloth over them, to prevent their opening; then laid on a ground of white; laftly, they mixed up their colours with water and fize, or with water and yolks of eggs, well beaten with the branches of a fig tree, the juice whereof thus mixed with the eggs; and with this mixture they painted their pieces.

In limning, all colours are proper enough, except the white made of lime, which is only ufed in frefco. The azure and ultramarine muft always be mixed with fize or gum; but there are always applied two layers of hot fize before the fize colours are laid on: the colours are all ground in water each by itfelf; and, as they are required in working, are diluted with fize water. When the piece is finifhed, they go over it with the white of an egg well beaten; and then with varnifh, if required.

To limn, or draw a face in colours: Having all the materials in readinefs, lay the prepared colour on the card even and thin, free from hairs and fpots, over the place where the picture is to be. The ground being laid, and the party placed in a due pofition, begin the work, which is to be done at three fittings. At the firft you are only to dead-colour the face, which will require about two hours. At the fecond fitting, go over the work more curioufly, adding its particular graces or deformities. At the third fitting, finifh the whole; carefully remarking whatever may conduce to render the piece perfect, as the caft of the eyes, moles, fcars, geftures, and the like.

LIMOGES, an ancient town of France, in the late province of Guienne, and capital of the department of Upper Vienne, with a bifhop's fee. It is a trading place, and its horfes are in great efteem. It is feated on the river Vienne, in E. Long. 1. 20. N. Lat. 45. 50.

LIMOSIN, a late province of France, now the department of Upper Vienne, bounded on the north by La Marche, on the eaft by Auvergne, on the fouth by Quercy, and on the weft by Perigord and Angoumois. One part is very cold, but the other more temperate. It is covered with forefts of chefnut trees; and contains mines of lead, copper, tin, and iron; but the principal trade confifts in cattle and horfes.

LIMPET, a genus of fhell-fifh. See PATELLA, CONCHOLOGY *Index*.

LIMPURG, a barony of Germany, in the circle of Franconia, included almoft entirely within Suabia, and feated to the fouth of Hall in Suabia. It is about 15 miles long, and eight broad. Gaildorf and Shonburg, near which is the caftle of Limpurg, are the principal places.

LIMPURG, a town of Germany, in the electorate of Triers or Treves, and in Wetteravia, formerly free and imperial, but now fubject to the electorate of Treves. It is feated on the river Lhon. E. Long. 8. 13. N Lat. 50. 18.

LINARIA. See FRINGILLA, ORNITHOLOGY *Index*.

LINACRE, THOMAS, phyfician, was born at Canterbury about the year 1460, and there educated under the learned William Selling: thence he removed to Oxford, and in 1484 was chofen fellow of All-Soul's college. Tilly, *alias* Selling, his former inftructor, being at this time appointed ambaffador from King Henry VII. to the court of Rome, Mr Linacre accompanied him to Italy, where he attained the higheft degree of perfection in the Greek and Latin languages. At Rome, he applied himfelf particularly to the ftudy of Ariftotle and Galen, in the original. On his return to Oxford, he was incorporated doctor of phyfic, and chofen public profeffor in that faculty. But he had not been long in England, before he was commanded to court by King Henry VII. to attend the young prince Arthur as his tutor and phyfician. He was afterwards appointed phyfician to the king, and after his death, to his fucceffor Henry VIII. Dr Linacre founded two medical lectures at Oxford, and one at Cambridge; but that which moft effectually immortalized his name among the faculty, is his being the firft founder of the college of phyficians in London. He beheld with vexa-

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tion the wretched ſtate of phyſic in thoſe times; and, by an application to Cardinal Wolſey, obtained a patent in 1518, by which the phyſicians of London were incorporated. The intention of this corporation was to prevent illiterate and ignorant medicaſters from practiſing the art of healing. Dr Linacre was the firſt preſident, and held the office as long as he lived. Their meetings were in his own houſe in Knight-rider ſtreet, which houſe he bequeathed to the college. But our doctor, when he was about the age of 50, took it into his head to ſtudy divinity; entered into orders; and was collated, in 1509, to the rectory of Merſham. In the ſame year he was inſtalled prebendary of Wells, in 1518 prebendary of York, and in the following year was admitted precentor of that cathedral. This, we are told, he reſigned for other preferments. He died of the ſtone in the bladder in October 1524, aged 64; and was buried in St Paul's. Thirty-three years after his death, Doctor John Caius cauſed a monument to be erected to his memory, with a Latin inſcription, which contains the outlines of his life and character. He was a man of great natural ſagacity, a ſkilful phyſician, a profound grammarian, and one of the beſt Greek and Latin ſcholars of his time. Eraſmus in his epiſtles ſpeaks highly of the Doctor's tranſlations from Galen, preferring them even to the original Greek. His works are, 1. *De emendata ſtructura Latini ſermonis, libri ſex;* London, printed by Pynſon, 1524, 8vo, and by Stephens, 1527, 1532. 2. The Rudiments of Grammar, for the uſe of the princeſs Mary, printed by Pynſon. Buchanan tranſlated it into Latin; Paris, 1536. He likewiſe tranſlated into very elegant Latin ſeveral of Galen's works, which were printed chiefly abroad at different times. Alſo *Procli Diadachi ſphæra*, tranſlated from the Greek; Venet. 1499, 1500.

LINCOLN, a city of England, and capital of a county of the ſame name, is diſtant 132 miles from London. It ſtands on the ſide of a hill; at the bottom of which runs the river Witham in three ſmall channels, over which are ſeveral bridges. The old *Lindum* of the Britons, which ſtood on the top of the hill, as appears from the veſtiges of a rampart, and deep ditches ſtill remaining, was taken and demoliſhed by the Saxons; who built a town upon the ſouth ſide of the hill down to the river ſide, which was ſeveral times taken by the Danes, and as often retaken by the Saxons. In Edward the Confeſſor's time, it appears, from Doomſday-book, to have been a very conſiderable place; and in the time of the Normans, Malmſbury ſays, it was one of the moſt populous cities in England. William I. built a caſtle upon the ſummit of the hill above the town. The dioceſe, though the biſhopric of Ely was taken out of it by Henry II. and thoſe of Peterborough and Oxford by Henry VIII. is ſtill vaſtly large, containing the counties of Leiceſter, Huntingdon, Bedford, and part of Bucks, making 1255 pariſhes. Though the other churches are mean, the cathedral or minſter is a moſt magnificent piece of Gothic architecture. Here is a prodigious large bell, called *Tom of Lincoln*, which is near five ton in weight, and 23 feet in compaſs. The hill on which the church ſtands is ſo high, and the church itſelf ſo lofty, that it may be ſeen 50 miles to the north and 30 to the ſouth. Beſides other tombs, it contains one of braſs, in which are the entrails of Queen Eleanor, wife to Edward I. It is ſaid there were anciently 52 churches, which are now reduced to 14. Such is the magnificence and elevation of the cathedral, that the monks thought the ſight of it muſt be very mortifying to the devil; whence it came to be ſaid of one who was diſpleaſed, *that he looked like the devil over Lincoln.* The declivity on which the city is built being ſteep, the communication betwixt the upper and lower town is very troubleſome, and coaches and horſes are obliged to make a compaſs.

King Edward III. made this city a ſtaple for wool, leather, lead, &c. It was once burnt; once beſieged by King Stephen, who was here defeated and taken priſoner; and once taken by Henry III. from his rebellious barons. It abounded heretofore with monaſteries and other religious houſes. There is a great pool here, formed by the river on the weſt ſide of it, called *Swan Pool*, becauſe of the multitude of ſwans on it. The Roman north gate ſtill remains entire, by the name of *Newport Gate.* It is one of the nobleſt of this ſort in Britain. It is a vaſt ſemicircle of ſtones of very large dimenſions laid without mortar, connected only by their uniform ſhape. This magnificent arch is 16 feet in diameter, the ſtones are four feet thick at the bottom. It ſeems to have a joint in the middle not a keyſtone: and on both ſides, towards the upper part, are laid horizontal ſtones of great dimenſions, ſome 10 or 12 feet long. This arch riſes from an impoſt of large mouldings, which are not perceivable now; there are alſo divers fragments of the old Roman wall. Over againſt the caſtle is an entrenchment caſt up by King Stephen; and here are carved the arms of John of Gaunt duke of Lancaſter, who lived here like a king, and had a mint. The city has a communication with the Trent, by a canal called the Foſs-dyke. In the centre of the old ruined caſtle there is a handſome modern ſtructure for holding the aſſizes. Its walls are almoſt entire, and very ſubſtantial: the keep or principal tower is ſituated on a high and very ſteep mount, which yet continues in its original ſtate, but the remains of the tower on it are only five or ſix yards high. The outer walls of the caſtle are of very conſiderable height, which appear ſtill higher than they really are from their lofty ſituation and the moat below them. The great gateway is ſtill entire. This city is a county of itſelf, and has a viſcountial juriſdiction, for 20 miles round, which is a privilege that no other city in England can equal. It now conſiſts principally of one ſtreet above two miles long, well paved, beſides ſeveral croſs and parallel ſtreets well peopled. Here are ſome very handſome modern buildings, but more antique ones; upon the whole, it has an air of ancient greatneſs, ariſing in a great meaſure from the number of monaſtic remains, moſt of which are now converted into ſtables, out-houſes, &c. Upon the hill, in the caſtle, are the ruins of the biſhop's palace, and other ruins of ancient grandeur and magnificence. The city is ſupplied with water by ſeveral conduits, among which is a modern one, ſomewhat in the pyramidical ſtyle, enriched with ſculpture. It is governed by a mayor, twelve aldermen, two ſheriffs, a recorder, four chamberlains, a ſwordbearer, four coroners, and above forty common-council men. Here are four charity ſchools, where 120 poor children are taught by the

the widows of clergymen. The neighbouring courſe is noted for its frequent horſe-races. On the down of Lincoln, towards Boſton, that rare fowl the buſtard is ſometimes ſeen, as well as on Saliſbury Plain. Lincoln-Heath extends above 50 miles, viz. from Sleaford and Ancaſter ſouth to the Humber north, though it is but three or four miles over where broadeſt. Five miles from Boſton on this extenſive heath, Lord le Deſpenſer built a tower for the direction of ſtrangers. It is a lofty ſquare building with a ſtaircaſe, terminating in a flat roof, and round the baſe is a ſquare court-yard. Great part of this extenſive heath has been encloſed. We read that David king of Scots met King John here, on the 22d of November, in the third year of his reign, and performed homage to him on a hill without the city, for his Engliſh territories, in preſence of the archbiſhops of Canterbury, York, and Raguſa, 13 biſhops, and a vaſt number of temporal lords and knights. King Henry VII. kept his court here at Eaſter in 1486. The Jews were once its chief inhabitants, till they were forced to remove, after having impiouſly crucified the child of one Grantham, and thrown it into a well, to this day called *Grantham's Well.* Lincoln has given the title of earl to the family of Clinton ever ſince the reign of Queen Elizabeth. W. Long. 27. 1. N. Lat. 53. 16.

Lincoln Shire, a maritime county of England, 77 miles in length and 48 in breadth, is bounded on the eaſt by the German ocean, on the weſt by Nottinghamſhire, on the north by Yorkſhire, on the ſouth by Rutlandſhire, Northamptonſhire, and Cambridgeſhire. It contains 631 pariſhes, and 31 market towns, and returns 12 members to parliament. The principal rivers are the Humber, the Trent, the Witham, the Nenn, the Welland, the Ankham, and the Dun. It is divided into three parts, Lindſay, Keſtoven, and Holland; the air of which laſt is unwholeſome and foggy, on account of the fens and large marſhes. The ſoil of the north and weſt parts is very fertile, and abounds in corn and paſtures. The eaſt and ſouth parts are not ſo proper for corn; but then they ſupply them with fiſh and fowl in great plenty, particularly ducks and geeſe. Lincoln is the principal town. By inland navigation, this county has communication with the rivers Merſey, Dee, Ribble, Ouſe, Darwent, Severn, Thames, Avon, &c. which navigation, including its windings, extends above 500 miles through different counties.

This county in 1801, contained 41,395 houſes, inhabited by 42,629 families; and the total number of inhabitants amounted to 208,557.

LINDESFARN, or Landisfarn. See *Holy-Iſland.*

LINDSAY, Sir David, a celebrated Scots poet, was deſcended of an ancient family, and born in the reign of King James IV. at his father's ſeat, called the *Mount*, near Cupar, in Fifeſhire. He was educated at the univerſity of St Andrew's; and, after making the tour of Europe, returned to Scotland in the year 1514. Soon after his arrival, he was appointed gentleman of the bedchamber to the king, and tutor to the young prince, afterwards James V. From the verſes prefixed to his dream, we learn that he enjoyed ſeveral other honourable employments at court: but, in 1533, he was deprived of all his places, except that of *Lion king at arms*, which he held to the time of his death. His diſgrace was moſt probably owing to his invectives againſt the clergy, which are frequent in all his writings. After the deceaſe of King James V. Sir David became a favourite of the earl of Arran, regent of Scotland; but the abbot of Paiſley did not ſuffer him to continue long in favour with the earl. He then retired to his paternal eſtate, and ſpent the remainder of his days in rural tranquillity. He died in the year 1553. His poetical talents, conſidering the age in which he wrote, were not contemptible; but he treats the Romiſh clergy with great ſeverity, and writes with ſome humour: but, whatever merit might be formerly attributed to him, he takes ſuch licentious liberties with words, ſtretching or carving them for meaſure or rhime, that the Scots have a proverb, when they hear an unuſual expreſſion, that, *There is nae ſic a word in a' Davie Lindſay.* Mackenzie tells us, that his comedies were ſo facetious, that they afforded abundance of mirth. Some fragments of theſe comedies are ſtill preſerved in manuſcript. He is ſaid to have alſo written ſeveral tragedies, and to have firſt introduced dramatic poetry into Scotland. One of his comedies was played in 1515. Mackenzie ſays, he underſtood nothing of the rules of the theatre. He was cotemporary with John Heywood, the firſt Engliſh dramatic poet. His poems are printed in one ſmall volume; and fragments of his plays, in manuſcript, are in Mr William Carmichael's collection.

LINDSEY, the third and largeſt diviſion of the county of Lincolnſhire in England. On the eaſt and north it is waſhed by the ſea, into which it runs out with a large front; on the weſt it has Yorkſhire and Nottinghamſhire, from which it is parted by the rivers Trent and Dun; on the ſouth it has Keſtevan, from which it is ſeparated by the river Witham and the Foſs-dyke, which is ſeven miles long, and was cut by Henry I. between the Witham and the Trent, for the convenience of carriage in thoſe parts. It had its name from Lincoln, the capital of the county, which ſtands in it, and by the Romans called *Lindum*, by the Britons *Lindcoite*, by the Saxons *Lindo-collyne*, probably from its ſituation on a hill, and the lakes or woods that were anciently thereabouts; but the Normans called it *Nichol.* It gives title of earl and marquis to the duke of Ancaſter.

LINDUS, in *Ancient Geography*, a town of Rhodes, ſituated on a hill on the weſt ſide of the iſland. It was built by Tlepolemus the ſon of Hercules, according to Diodorus Siculus; by one of the Heliades, grandſons of the Sun, named *Lindus*, according to Strabo. It was the native place of Cleobulus, one of the wiſe men. Here we ſee the famous temple of the Lindian Minerva, which was built by the daughters of Danaus. Cadmus enriched this temple with many ſplendid offerings. The citizens dedicated and hung up here the ſeventh of Pindar's Olympic odes, written in letters of gold. The ruins of that ſuperb edifice are ſtill to be ſeen on the top of a high hill which overlooks the ſea. Some remains of the walls, conſiſting of ſtones of an enormous ſize, ſtill ſhow it to have been built in the Egyptian ſtyle. The pillars and other ornaments have been carried off. On the moſt elevated peak of the rock are the ruins of a caſtle, which may have ſerved as a fortreſs to the city. Its circumference is very extenſive, and is filled with rubbiſh.

Lindo, the modern city, ftands at the foot of the hill. A bay of confiderable widenefs and depth ferves as a harbour to the city. Ships find good anchorage there in twenty fathoms water. They are fafely fheltered from the fouth-weft winds, which conftantly prevail through the fevereft feafon of the year. In the beginning of winter, they caft anchor off a fmall village named Maffary. Before the building of Rhodes, Lindus was the harbour which received the fleets of Egypt and Tyre. It was enriched by commerce. Mr Savary obferves, that a judicious government, by taking advantage of its harbour and happy fituation, might yet reftore it to a flourifhing ftate.

LINE, in *Geometry*, a quantity extended in length only, without any breadth or thicknefs. It is formed by the flux or motion of a point. See FLUXIONS, and GEOMETRY.

LINE, in the art of war, is underftood of the difpofition of an army ranged in order of battle, with the front extended as far as may be, that it may not be flanked.

LINE of Battle, is alfo underftood of a difpofition of the fleet in the day of engagement; on which occafion the veffels are ufually drawn up as much as poffible in a ftraight line, as well to gain and keep the advantage of the wind as to run the fame board. See *Naval TACTICS*.

Horizontal LINE, in *Geography* and *Aftronomy*, a line drawn parallel to the horizon of any part of the earth.

Equinoctial LINE, in *Geography*, is a great circle on the earth's furface, exactly at the diftance of 90° from each of the poles, and of confequence bifecting the earth in that part. From this imaginary line, the degrees of longitude and latitude are counted.—In aftronomy, the equinoctial line is that circle which the fun feems to defcribe round the earth on the days of the equinox in March and September. See ASTRONOMY and GEOGRAPHY.

Meridian LINE, is an imaginary circle drawn through the two poles of the earth and any part of its furface. See GEOGRAPHY *Index*.

Ship of the LINE, a veffel large enough to be drawn up in the line, and to have a place in a feafight.

LINE, in *Genealogy*, a feries or fucceffion of relations in various degrees, all defcending from the fame common father. See DESCENT.

LINE, alfo denotes a French meafure containing the 12th part of an inch, or the 144th part of a foot. Geometricians conceive the line fubdivided into fix points. The French line anfwers to the Englifh barley-corn.

Fifhing LINE. See *FISHING Line*.

LINES, in *Heraldry*, the figures ufed in armories to divide the fhield into different parts, and to compofe different figures. Thefe lines, according to their different forms and names, give denomination to the pieces or figures which they form, except the ftraight or plain lines. See HERALDRY.

LINEA ALBA, in *Anatomy*, the concourfe of the tendons of the oblique and tranfverfe mufcles of the abdomen; dividing the abdomen in two, in the middle. It is called *linea*, line, as being ftraight; and *alba*, from its colour, which is white.—The *linea alba* receives a twig of a nerve from the intercoftals in each of its digitations or indentings, which are vifible to the eye, in lean perfons efpecially.

LINEAMENT, among painters, is ufed for the outlines of a face.

LINEAR NUMBERS, in *Mathematics*, fuch as have relation to length only; fuch is a number which reprefents one fide of a plain figure. If the plain figure be a fquare, the linear figure is called a *root*.

LINEAR Problem; that which may be folved geometrically by the interfection of two right lines. This is called a *fimple problem*, and is capable but of one folution.

LINEN, in commerce, a well known kind of cloth, chiefly made of flax.—Linen was not worn by the Jews, Greeks, or Romans, as any part of their ordinary drefs. Under-tunics of a finer texture fupplied the place of fhirts: Hence the occafion for frequent bathing. Alexander Severus was the firft emperor who wore a fhirt: but the ufe of fo neceffary a garment did not become common till long after him.

The linen manufacture was probably introduced into Britain with the firft fettlements of the Romans. The flax was certainly firft planted by that nation in the Britifh foil. The plant itfelf indeed appears to have been originally a native of the eaft. The woollen-drapery would naturally be prior in its origin to the linen; and the fibrous plants from which the threads of the latter are produced, feem to have been firft noticed and worked by the inhabitants of Egypt. In Egypt, indeed, the linen manufacture appears to have been very early: for even in Jofeph's time it had rifen to a confiderable height. From the Egyptians the knowledge of it proceeded probably to the Greeks, and from them to the Romans. Even at this day the flax is imported among us from the eaftern nations; the weftern kind being merely a degenerate fpecies of it.

In order to fucceed in the linen manufacture, one fet of people fhould be confined to the ploughing and preparing the foil, fowing and covering the feed, to the weeding, pulling, rippling, and taking care of the new feed, and watering and dreffing the flax till it is lodged at home: others fhould be concerned in the drying, breaking, fcutching, and heckling the flax, to fit it for the fpinners; and others in fpinning and reeling it, to fit it for the weaver: others fhould be concerned in taking due care of the weaving, bleaching, beetling, and finifhing the cloth for the market. It is reafonable to believe, that if thefe feveral branches of the manufacture were carried on by diftinct dealers in Scotland and Ireland, where our home-made linens are manufactured, the feveral parts would be better executed, and the whole would be afforded cheaper, and with greater profit.

Staining of LINEN. Linen receives a black colour with much more difficulty than woollen or cotton. The black ftruck on linen with common vitriol and galls, or logwood, is very perifhable, and foon wafhes out.—Inftead of the vitriol, a folution of iron in four ftrong beer is to be made ufe of. This is well known to all the calico-printers; and by the ufe of this, which they call their *iron-liquor*, and madder root, are the blacks and purples made which we fee on the common printed linens.

The

The method of making this iron-liquor is as follows: A quantity of iron is put into the four ftrong beer; and, to promote the diffolution of the metal, the whole is occafionally well ftirred, the liquor occafionally drawn off, and the ruft beat from the iron, after which the liquor is poured on again. A length of time is required to make the impregnation perfect; the folution being reckoned unfit for ufe till it has ftood at leaft a twelvemonth. This folution ftains the linen of a yellow, and different fhades of buff-colour; and is the only known fubftance by which thefe colours can be fixed on linen. The cloth ftained deep with the iron-liquor, and afterwards boiled with madder, without any other addition, becomes of the dark colour which we fee on printed linens and cottons; which, if not a perfect black, has a very near refemblance to it. Others are ftained paler with the fame liquor diluted with water, and come out purple.

Linen may alfo be ftained of a durable purple by means of folution of gold in aqua regia. The folution for this purpofe fhould be as fully faturated as poffible; it fhould be diluted with three times its quantity of water; and if the colour is required deep, the piece, when dry, muft be repeatedly moiftened with it. The colour does not take place till a confiderable time, fometimes feveral days, after the liquor has been applied: to haften its appearance, the fubject fhould be expofed to the fun and free air, and occafionally removed to a moift place, or moiftened with water.—When folution of gold in aqua regia is foaked up in linen cloths, the metal may be recovered by drying and burning them.

Linen flowered with Gold-leaf. Dr Lewis mentions a manufacture eftablifhed in London for embellifhing linen with flowers and ornaments of gold-leaf. The linen, he fays, looks whiter than moft of the printed linens; the gold is extremely beautiful, and bears wafhing well. The doctor informs us, that he had feen a piece which he was credibly informed had been wafhed three or four times, with only the fame precautions which are ufed for the finer printed linens; and on which the gold continued entire, and of great beauty. Concerning the procefs ufed in this manufacture, he gives us no particulars.

Foffile Linen, is a kind of amianthus, which confifts of flexible, parallel, foft fibres, and which has been celebrated for the ufes to which it has been applied, of being woven, and forming an *incombuftible cloth*. Paper alfo, and wicks for lamps, have been made of it. See Amianthus, Asbestos, and Mineralogy *Index*.

LING, a fpecies of fifh belonging to the genus Gadus, which fee in Ichthyology *Index*.

LINGEN, a ftrong town of Germany, in the circle of Weftphalia, and capital of a county of the fame name. It belongs to the king of Pruffia; and is fituated on the river Embs, in E. Long. 7. 30. N. Lat. 52. 32.

LINIMENT, in *Pharmacy*, a compofition of a confiftence fomewhat thinner than an unguent, and thicker than an oil. See Materia Medica *Index*.

LINLITHGOW, the chief town of Weft Lothian in Scotland. It is fuppofed to be the *Lindum* of Ptolemy; and to take its name from its fituation on a lake, which the word *Lin* or *Llyn* fignifies.—It is diftant 16 miles from Edinburgh, and is a royal borough and feat of a prefbytery. Here is carried on a confiderable trade in dreffing of white leather, which is fent abroad to be manufactured; and many hands are employed in dreffing of flax; alfo in wool-combing, the wool for which is brought from the borders. Its port was formerly *Blacknefs*; but fince the decline of that place, *Borrowftounnefs*, about two miles diftant from Linlithgow. The town confifts of one open ftreet, from whence lanes are detached on both fides; the houfes are built of ftone, tolerably neat and commodious; and the place is adorned with fome ftately public edifices. The palace, built, as Sibbald fuppofed, on the feat of a Roman ftation, forms a fquare with towers at the corners, and ftands on a gentle eminence, with the beautiful loch behind it to the weft. It was one of the nobleft of the royal refidences; and was greatly ornamented by James V. and VI. Within the palace is a handfome fquare; one fide of which is more modern than the others, having been built by James VI. and kept in good repair till 1746, when it was accidentally damaged by the king's forces making fires on the hearths, by which means the joifts were burnt. A ftone ornamented fountain in the middle of the court was deftroyed at the fame time. The other fides of the fquare are more ancient. In one is a room ninety-five feet long, thirty feet fix inches wide, and thirty-three high. At one end is a gallery with three arches, perhaps for mufic. Narrow galleries run quite round the old part, to preferve communication with the rooms; in one of which the unfortunate Mary Stuart firft faw light. On the north fide of the high ftreet, on an eminence eaft of the palace, ftands St Michael's church; a handfome ftructure, where James V. intended to have erected a throne and twelve ftalls for the fovereign and knights of the order of St Andrew. In the market-place is another fountain of two ftories with eight fpouts, and furmounted like the former with an imperial crown. In one of the ftreets is fhown the gallery where the regent Murray was fhot. Here was a houfe of Carmelites, founded by the townfpeople in 1290, deftroyed by the Reformers 1559. The family of Livingfton, who took the title of earl from this place, were hereditary keepers of this palace, as alfo bailiffs of the king's bailifry, and conftables of Blacknefs caftle; but by their concern in the rebellion of 1715 all thefe honours with their eftate were forfeited to the crown. Sir James Livingfton, fon of the firft earl by marriage with a daughter of Callendar, was created earl of Callendar by Charles I. 1641, which title funk into the other.

LINLITHGOWSHIRE, or West Lothian, nearly approaches in form to a parallelogram, about 20 miles long from eaft to weft, and from 10 to 13 broad, from north to fouth. It is bounded by the river Forth on the north; by the river Amond on the fouth-eaft; by Lanarkfhire on the fouth-weft; and by the river Avon on the weft. It is allowed to be one of the richeft counties in Scotland, the foil in general being a rich loam, in a high ftate of cultivation and improvement. Its furface is diverfified by gentle fwells and fertile plains; and the number of elegant feats almoft every where to be met with, gives it both a rich and delightful appearance. The whole is a compofition of all that is great and beautiful; towns, villages, feats, and ancient towers, decorate each bank of that fine expanfe of water, the frith of Forth. The lofty mountains

Linlithgowshire, Linnæus. tains of the Highlands form a diftant, but auguft boundary towards the north-weft; and the eaftern view is enlivened with fhips perpetually appearing or vanifhing, amidft the numerous iflands. Hopetoun-houfe, Barnbougle-caftle, Calder-houfe, Craigie-hall, and the feat of General Dundas, are fome of the principal ornaments of this county. It contains two royal boroughs, Linlithgow and Queensferry, befides the towns of Borrowftounnefs, Bathgate, and Kirkliftoun. It is poorly fupplied with running water, the Avon and Amond being the only ftreams which are deferving of notice. There are many valuable minerals found in it in abundance, fuch as coal, limeftone, and fome lead ore. In the reign of James VI. a vein of lead was difcovered, fo rich in filver, that it was thought worthy of being wrought for the fake of that metal alone. Almoft every parifh abounds with ironftone, which is extenfively wrought in the parifh of Bathgate. In many places there are appearances of whinftone or bafalt, particularly at Dundas-hill, in the parifh of Dalmeny, where there is a folid front of bafaltic rock, exhibiting in fome places regular columns. The population of this county in 1801 amounted to 17,844. The following is the population of the parifhes according to the Statiftical Hiftory.

	Parifhes.		Population in 1755.	Population in 1790—1798.
1	Abercorn	-	1037	870
	Bathgate	-	1594	2309
	Borrowftounnefs	-	2668	3178
	Carriden	-	1164	1450
5	Dalmeny	-	1103	907
	Ecclefmachan	-	351	215
	Kirkliftoun	-	1461	1504
	Linlithgow	-	3296	3221
	Livingftone	-	598	420
10	Queensferry	-	451	505
	Torphichen	-	1295	1069
	Uphall	-	690	600
13	Whitburn	-	1121	1322
			16,829	17,570
				16,829
				Increafe, 741

LINNÆUS, Sir Charles, a celebrated botanift and natural hiftorian, was born on May 24. 1707, in a village called *Roefhult* in Smaland, where his father, Nicholas Linnæus, was then vicar, but afterwards preferred to the curacy of Stenbrohult. We are told, that on the farm where Linnæus was born, there yet ftands a large lime tree, from which his anceftors took the furnames of *Tiliander*, *Lindelius*, and *Linnæus*; and that this origin of furnames, taken from natural objects, is not uncommon in Sweden.

This eminent man, whofe talents enabled him to reform the whole fcience of natural hiftory, accumulated, very early in life, fome of the higheft honours that await the moft fuccefsful proficients in medical fcience; fince we find that he was made profeffor of phyfic and botany, in the univerfity of Upfal, at the age of 34; and fix years afterwards, phyfician to Adolphus king of Sweden; who in the year 1753 honoured him ftill farther, by creating him knight of the order of the

2

Polar Star. His honours did not terminate here: for in 1757 he was ennobled; and in 1776 the king of Sweden accepted the refignation of his office, and rewarded his declining years by doubling his penfion, and by a liberal donation of landed property fettled on him and his family. Linnæus. From Dr Pultney's General View of the Life and Writings of Linnæus.

It feems probable, that Linnæus's tafte for the ftudy of nature was caught from the example of his father; who, as he has himfelf informed us, cultivated, as his firft amufement, a garden plentifully ftored with plants. Young Linnæus foon became acquainted with thefe, as well as with the indigenous ones of his neighbourhood. Yet, from the ftraitnefs of his father's income, our young naturalift was on the point of being deftined to a mechanical employment; fortunately, however, this defign was over-ruled. In 1717 he was fent to fchool at Wexfio; where, as his opportunities were enlarged, his progrefs in all his favourite purfuits was proportionably extended. At this early period he paid attention to other branches of natural hiftory, particularly to the knowledge of infects.

The firft part of his academical education Linnæus received under Profeffor Stobæus, at Lund, in Scania, who favoured his inclinations to the ftudy of natural hiftory. After a refidence of about a year, he removed in 1728 to Upfal. Here he foon contracted a clofe friendfhip with Artedi, a native of the province of Angermania, who had already been four years a ftudent in that univerfity, and, like himfelf, had a ftrong bent to the ftudy of natural hiftory in general, but particularly to ichthyology. Soon after his refidence at Upfal, our author was alfo happy enough to obtain the favour of feveral gentlemen of eftablifhed character in literature. He was in a particular manner encouraged in the purfuit of his ftudies by the patronage of Dr Olaus Celfius, at that time profeffor of divinity, and the reftorer of natural hiftory in Sweden; who, being ftruck with the diligence of Linnæus in defcribing the plants of the Upfal garden, and his extenfive knowledge of their names, not only patronized him in a general way, but admitted him to his houfe, his table, and his library. Under fuch encouragement it is not ftrange that our author made a rapid progrefs, both in his ftudies and the efteem of the profeffors: in fact, we have a very ftriking proof of his merit and attainments; fince we find, that, after only two years refidence, he was thought fufficiently qualified to give lectures occafionally from the botanic chair, in the room of Profeffor Rudbeck.

In the year 1731, the Royal Academy of Sciences at Upfal having for fome time meditated the defign of improving the natural hiftory of Sweden, at the inftance particularly of Profeffors Celfius and Rudbeck, deputed Linnæus to make the tour of Lapland, with the fole view of exploring the natural hiftory of that arctic region; to which undertaking, his reputation, already high as a naturalift, and the ftrength of his conftitution, equally recommended him. He left Upfal the 13th of May, and took his route to Gevalia or Gevels, the principal town of Geftricia, 45 miles diftant from Upfal. Hence he travelled through Helfingland into Medalpadia, where he made an excurfion, and afcended a remarkable mountain before he reached Hudwickfwald, the chief town of Helfingland. From hence he went through Angermanland to Hernofand, Linnæus.

nofand, a fea-port on the Bothnic gulf, 76 miles diftant from Hudwickfwald. When he had proceeded thus far, he found it proper to retard his journey, as the fpring was not fufficiently advanced; and took this opportunity of vifiting thofe remarkable caverns on the fummit of Mount Skula, though at the hazard of his life.

When Linnæus arrived at Uma, in Weft Bothnia, about 96 miles from Hernofand, he quitted the public road, and took his courfe through the woods weftward, in order firft to traverfe the moft fouthern parts of Lapland. Being now come to the country that was more particularly the object of his inquiries, equally a ftranger to the language and to the manners of the people, and without any affociate, he committed himfelf to the hofpitality of the inhabitants, and never failed to experience it fully. He fpeaks in feveral places, with peculiar fatisfaction, of the innocence and fimplicity of their lives, and their freedom from difeafes. In this excurfion he reached the mountains towards Norway; and, after encountering great hardfhips, returned into Weft Bothnia, quite exhaufted with fatigue. Our traveller next vifited Pitha and Lula, upon the gulf of Bothnia; from which latter place he took again a weftern route, by proceeding up the river of that name, and vifited the ruins of the temple of Jockmock in Lula Lapland or Lap Mark: thence he traverfed what is called the *Lapland Defert*, deftitute of all villages, cultivation, roads, or any conveniences; inhabited only by a few ftraggling people, originally defcended from the Finlanders, and who fettled in this country in remote ages, being entirely a diftinct people from the Laplanders. In this diftrict he afcended a noted mountain called *Wallevari;* in fpeaking of which he has given us a pleafant relation of his finding a fingular and beautiful new plant (*Andromeda tetragona*) when travelling within the arctic circle, with the fun in his view at midnight, in fearch of a Lapland hut. From hence he croffed the Lapland Alps into Finmark, and traverfed the fhores of the North fea as far as Sallero.

Thefe journeys from Lula and Pitha on the Bothnian gulf, to the north fhore, were made on foot; and our traveller was attended by two Laplanders, one his interpreter, and the other his guide. He tells us, that the vigour and ftrength of thefe two men, both old, and fufficiently loaded with his baggage, excited his admiration; fince they appeared quite unhurt by their labour, while he himfelf, although young and robuft, was frequently quite exhaufted. In this journey he was wont to fleep under the boat with which they forded the rivers, as a defence againft rain, and the gnats, which in the Lapland fummer are not lefs teafing than in the torrid zones. In defcending one of thefe rivers, he narrowly efcaped perifhing by the overfetting of the boat, and loft many of the natural productions which he had collected.

Linnæus thus fpent the greater part of the fummer in examining this arctic region, and thofe mountains on which, four years afterwards, the French philofophers fecured immortal fame to Sir Ifaac Newton. At length, after having fuffered incredible fatigues and hardfhips, in climbing precipices, paffing rivers in miferable boats, fuffering repeated viciffitudes of extreme heat and cold, and not unfrequently hunger and thirft, he returned to Tornea in September. He did not take the fame route from Tornea as when he came into Lapland, having determined to vifit and examine the country on the eaftern fide of the Bothnian gulf: his firft ftage, therefore, was to Ula in Eaft Bothnia; from thence to Old and New Carlebay, 84 miles fouth from Ula. He continued his route through Wafa, Chriftianftadt, and Biorneburgh, to Abo, a fmall univerfity in Finland. Winter was now fetting in apace; he therefore croffed the gulf by the ifland of Aland, and arrived at Upfal in November, after having performed, and that moftly on foot, a journey of ten degrees of latitude in extent, exclufively of thofe deviations which fuch a defign rendered neceffary.

In 1733 he vifited and examined the feveral mines in Sweden; and made himfelf fo well acquainted with mineralogy and the docimaftic art, that we find he was fufficiently qualified to give lectures on thofe fubjects upon his return to the univerfity. The outlines of his fyftem on mineralogy appeared in the early editions of the *Syftema Naturæ;* but he did not exemplify the whole until the year 1768.

In the year 1734 Linnæus was fent by Baron Reuterholm, governor of Dalecaria, with feveral other naturalifts in that province, to inveftigate the natural productions of that part of the Swedifh dominions; and it was in this journey that our author firft laid the plan of an excellent inftitution, which was afterwards executed, in a certain degree at leaft, by himfelf, with the affiftance of many of his pupils, and the refult publifhed under the title of *Pan Suecicus*, in the fecond volume of the *Amœnitates Academicæ*.

After the completion of this expedition, it appears that Linnæus refided for a time at Fahlun, the principal town in Dalecarlia; where he tells us, that he taught mineralogy and the docimaftic art, and practifed phyfic; and where he was very hofpitably treated by Dr More, the phyfician of the place. It alfo appears, that he contracted at this time an intimacy with one of that gentleman's daughters, whom he married about five years afterwards upon his fettling as a phyfician at Stockholm.—In this journey he extended his travels quite acrofs the Dalecarlian Alps into Norway; but we have no particular account of his difcoveries in that kingdom. In 1735 Linnæus travelled over many other parts of Sweden, fome parts of Denmark and Germany, and fixed in Holland, where he chiefly refided until his return to Stockholm, about the year 1739. In 1735, the year in which he took the degree of M. D. he publifhed the firft fketch of his *Syftema Naturæ*, in a very compendious way, and in the form of tables only, in 12 pages in folio. By this it appears that he had at a very early period of his life (certainly before he was 24 years old), laid the bafis of that great ftructure which he afterwards raifed, not only to the increafe of his own fame, but to that of natural fcience.

In 1736, Linnæus came into England, and vifited Dr Dillenius, the late learned profeffor at Oxford, whom he juftly confidered as one of the firft botanifts in Europe. He mentions with particular refpect the civilities he received from him, and the privileges he gave him of infpecting his own and the Sherardian collections of plants. It is needlefs to fay, that he vifited Dr Martyn, Mr Rand, and Mr Miller, and that

Linnæus. that he was in a more singular manner indebted to the friendship of Dr Isaac Lawson. He also contracted an intimate friendship with Mr Peter Collinson, which was reciprocally increased by a multitude of good offices, and continued to the last without any diminution. Dr Boerhaave had furnished him with letters to our great naturalist Sir Hans Sloane; but, it is with regret that we must observe, they did not procure him the reception which the warmth of his recommendation seemed to claim.

One of the most agreeable circumstances that happened to Linnæus during his residence in Holland, arose from the patronage of Mr Clifford, in whose house he lived a considerable part of his time, being now as it were the child of fortune:—*Exivi patriâ triginta sex nummis aureis dives*—are his own words. With Mr Clifford, however, he enjoyed pleasures and privileges scarcely at that time to be met with elsewhere in the world; that of a garden excellently stored with the finest exotics, and a library furnished with almost every botanic author of note. How happy he found himself in this situation, those only who have felt the same kind of ardour can conceive. Whilst in Holland, our author was recommended by Boerhaave to fill the place then vacant, of physician to the Dutch settlement at Surinam; but he declined it on account of his having been educated in so opposite a climate.

Besides being favoured with the particular patronage and friendship of Boerhaave and Mr Clifford, as is above mentioned, our author had also the pleasure of being contemporary with, and of reckoning among the number of his friends, many other learned persons who have since proved ornaments to their profession, and whose merit has most deservedly raised them to fame and honour. Among these we may properly mention Dr John Burman, professor of botany at Amsterdam, whose name and family are well known in the republic of letters, and to whom our author dedicated his *Bibliotheca Botanica*, having been greatly assisted in compiling that work by the free access he had to that gentleman's excellent library; John Frederick Gronovius of Leyden, editor of Clayton's *Flora Virginica*, and who very early adopted Linnæus's system; Baron Van Swieten, physician to the empress queen; Isaac Lawson, before mentioned, afterwards one of the physicians to the British army, who died much regretted at Oosterhout in the year 1747, and from whom Linnæus received singular and very important civilities; Kramer, since well known for an excellent treatise on the docimastic art; Van Royen, botanic professor at Leyden; Lieberkun of Berlin, famous for his skill in microscopical instruments and experiments. To these may be added also the names of Albinus and Gaubius, and of others, were it requisite to show that our author's talents had very early render him conspicuous, and gained him the regard of all those who cultivated and patronised any branch of medical science; and to which, doubtless, the singular notice with which Boerhaave honoured him did not a little contribute.

Early in the year 1738, after Linnæus had left Mr Clifford, and, as it should seem, when he resided with Van Royen, he had a long and dangerous fit of sickness; and upon his recovery went to Paris, where he was properly entertained by the Jussieus, at that time the first botanists in France. The opportunity this gave him of inspecting the Herbaria of Royen and Tournefort, and those of the above-named gentlemen, afforded him great satisfaction. He had intended to have gone from thence into Germany, to visit Ludwig and the celebrated Haller, with whom he was in close correspondence; but he was not able to complete this part of his intended route, and was obliged to return without this gratification. Linnæus.

Our author did not fail to avail himself of every advantage that access to the several museums of this country afforded him, in every branch of natural history; and the number and importance of his publications, during his absence from his native country, sufficiently demonstrate that fund of knowledge which he must have imbibed before, and no less testify his extraordinary application. These were *Systema Naturæ*, *Fundamenta Botanica*, *Bibliotheca Botanica*, and *Genera Plantarum*; the last of which is justly considered as the most valuable of all the works of this celebrated author. What immense application had been bestowed upon it, the reader may easily conceive, on being informed, that before the publication of the first edition the author had examined the characters of 8000 flowers. The last book of Linnæus's composition, published during his stay in Holland, was the *Classes Plantarum*, which is a copious illustration of the second part of the *Fundamenta*.

About the latter end of the year 1738, or the beginning of the next, our author settled as a physician at Stockholm; where he seems to have met with considerable opposition, and was oppressed with many difficulties; but all of these at length he overcame, and got into extensive practice; and soon after his settlement married the lady before spoken of. By the interest of Count Tessin, who was afterwards his great patron, and even procured medals to be struck in honour of him, he obtained the rank of physician to the fleet, and a stipend from the citizens for giving lectures in botany. And what at this time especially was highly favourable to the advancement of his character and fame, by giving him an opportunity of displaying his abilities, was the establishment of the Royal Academy of Sciences at Stockholm; of which Linnæus was constituted the first president, and to which establishment the king granted several privileges, particularly that of free postage to all papers directed to the secretary. By the rules of the academy, the president held his place but three months. At the expiration of that term, Linnæus made his *Oratio de memorabilibus in Insectis*, Oct. 3. 1739; in which he endeavours to excite an attention and inquiry into the knowledge of insects, by displaying the many singular phenomena that occur in contemplating the nature of those animals, and by pointing out, in a variety of instances, their usefulness to mankind in particular, and to the economy of nature in general.

During all this time, however, Linnæus appears to have had his eye upon the botanic and medical chair at Upsal, at this time occupied by Rudbeck, who was far advanced in life. We learn indeed that he was so intent on pursuing and perfecting his great designs in the advancement of his favourite study of nature, that he had determined, if he failed in procuring the

Linnæus.

the profeſſorſhip at Upſal, to accept the offer that had been made to him by Haller of filling the botanic chair at Gottingen. However, in courſe of time, he obtained his wiſh. In the year 1741, upon the reſignation of Roberg, he was conſtituted joint profeſſor of phyſic, and phyſician to the king, with Roſen, who had been appointed in the preceding year on the death of Rudbeck. Theſe two colleagues agreed to divide the medical departments between them; and their choice was confirmed by the univerſity. Roſen took anatomy, phyſiology, pathology, and the therapeutic part; Linnæus, natural hiſtory, botany, materia medica, the dietetic part, and the diagnoſis morborum.

During the interval of his removal from Stockholm to Upſal in conſequence of this appointment, our profeſſor was deputed by the ſtates of the kingdom to make a tour to the iſlands of Oëland and Gothland in the Baltic, attended by ſix of the pupils, commiſſioned to make ſuch inquiries as might tend to improve agriculture and arts in the kingdom, to which the Swediſh nation had for ſome time paid a particular attention. The reſult of this journey was very ſucceſsful, and proved fully ſatisfactory to the ſtates, and was afterwards communicated to the public. On his return he entered upon the profeſſorſhip, and pronounced before the univerſity his oration *de Peregrinationum intra Patriam neceſſitate*, October 17. 1741; in which he forcibly diſplays the uſefulneſs of ſuch excurſions, by pointing out to the ſtudents that vaſt field of objects which their country held out to their cultivation, whether in geography, phyſics, mineralogy, botany, zoology, or economics, and by ſhowing the benefit that muſt accrue to themſelves and their country as rewards to their diligence. That animated ſpirit which runs through the whole of this compoſition, renders it one of the moſt pleaſing and inſtructive of all our author's productions.

Linnæus was now fixed in the ſituation that was the beſt adapted to his character, his taſte, and abilities; and which ſeems to have been the object of his ambition and centre of his hopes. Soon after his eſtabliſhment, he laboured to get the academical garden, which had been founded in 1657, put on a better footing and very ſoon effected it; procuring alſo a houſe to be built for the reſidence of the profeſſor. The whole had been in ruins ever ſince the fire in 1702; and at the time Linnæus was appointed profeſſor of botany, the garden did not contain above fifty plants that were exotic. His correſpondence with the firſt botaniſts in Europe ſoon ſupplied him with great variety. He received Indian plants from Juſſieu of Paris, and from Van Royen of Leyden; European plants from Haller and Ludwig; American plants from the late Mr Collinſon, Mr Cateſby, and others; and variety of annuals from Dillenius: in ſhort, how much the garden owed to his diligence and care in a few years, may be ſeen by the catalogue publiſhed under the title of *Hortus Upſalienſis, exhibens Plantas exoticas horto Upſalienſis Academiæ à ſeſe (Linnæo) illatas ab anno* 1742, *in annum* 1748, *additis differentiis ſynonymis, habitationibus, hoſpitiis, rariorumque deſcriptionibus, in gratiam ſtudioſæ juventutis;* Holm. 1748, 8vo. pp. 306. tab. 3. By this catalogue it appears, that the profeſſor had introduced 1100 ſpecies, excluſively of all the Swediſh plants and of varieties: which latter, in ordinary gardens, amount not unfrequently to one-third of the whole number. The preface contains a curious hiſtory of the climate at Upſal, and the progreſs of the ſeaſons throughout the whole year.

From the time that Linnæus and Roſen were appointed profeſſors at Upſal, it ſhould ſeem that the credit of that univerſity, as a ſchool of phyſic, had been increaſing: numbers of ſtudents reſorted thither from Germany, attracted by the character of theſe two able men; and in Sweden itſelf many young men were invited to the ſtudy of phyſic by the excellent manner in which it was taught, who otherwiſe would have engaged in different purſuits.

Whilſt Linnæus was meditating one of his capital performances, which had long been expected and greatly wiſhed for, he was interrupted by a tedious and painful fit of the gout, which left him in a very weak and diſpirited ſtate; and, according to the intelligence that his friends gave of him, nothing was thought to have contributed more to the reſtoration of his ſpirits than the ſeaſonable acquiſition, at this juncture, of a collection of rare and undeſcribed plants.

The fame which our author had now acquired by his *Systema Naturæ*, of which a ſixth edition, much enlarged, had been publiſhed at Stockholm in 1748 in 8vo, pp. 232, with eight tables explanatory of the claſſes and orders (and which was alſo republiſhed by Gronovius at Leyden), had brought, as it were, a conflux of every thing rare and valuable in every branch of nature, from all parts of the globe, into Sweden. The king and queen of Sweden had their ſeparate collections of rarities; the former at Ulrickſdahl; the latter, very rich in exotic inſects and ſhells, procured at a great expence, at the palace of Drottningholm: both of which our author was employed in arranging and deſcribing. Beſides theſe, the muſeum of the Royal Academy of Upſal had been augmented by a conſiderable donation from the king, whilſt hereditary prince, in 1746; by another from Count Gyllenborg the year before; by a third from M. Grill, an opulent citizen of Stockholm.

From this time we ſee the profeſſor in a more elevated rank and ſituation in life. His reputation had already procured him honours from almoſt all the royal ſocieties in Europe; and his own ſovereign, truly ſenſible of his merit, and greatly eſteeming his character and abilities, favoured him with a mark of his diſtinction and regard, by creating him a knight of the Polar Star. It was no longer *laudatur et alget.* His emoluments kept pace with his fame and honours: his practice in his profeſſion became lucrative; and we find him ſoon after poſſeſſed of his country houſe and gardens at Hammarby, about five miles from Upſal. He had moreover received one of the moſt flattering teſtimonies of the extent and magnitude of his fame that perhaps was ever ſhown to any literary character, the ſtate of the nation which conferred it, with all its circumſtances, duly conſidered. This was an invitation to Madrid from the king of Spain, there to preſide as a naturaliſt, with the offer of an annual penſion for life of 2000 piſtoles, letters of nobility, and the perfect free exerciſe of his own religion: But, after the moſt perfect acknowledgements of the ſingular honour done him, he returned for anſwer, 'that

Linnæus. 'that if he had any merits, they were due to his own country.'

In the year 1755, the Royal Academy of Sciences at Stockholm honoured our professor with one of the first premiums, agreeably to the will of Count Sparree, who had decreed two gold medals, of ten ducats value each, to be annually given by the academy to the authors of such papers, in the preceding year's Stockholm Acts, as should be adjudged most useful in promoting agriculture particularly, and all branches of rural economy. This medal bore on one side the arms of the count, with this motto, *Superstes in scientiis amor Frederici Sparree.* Linnæus obtained it in consequence of a paper *De Plantis quæ Alpium Suecicarum indigenæ, magno rei œconomicæ et medicæ emolumento fieri possint;* and the ultimate intention was to recommend these plants as adapted to culture in Lapland. This paper was inserted in the Stockholm Acts for 1754, vol. xv. Linnæus also obtained the *præmium centum aureorum*, proposed by the Imperial Academy of Sciences at Petersburgh, for the best paper written to establish or disprove, by new arguments, the doctrine of the sexes of plants. It was, if possible, an additional glory to Linnæus to have merited this premium from the Petersburgh academy; inasmuch as a professor of that society, a few years before, had with more than common zeal, although with a futility like that of the other antagonists of our author, endeavoured to overturn the whole Linnæan system of botany, by attempting to show that the doctrine of the sexes of plants had no foundation in nature, and was unsupported by facts and experiments.

It appears that Linnæus upon the whole, enjoyed a good constitution; but that he was sometimes severely afflicted with a *hemicrania*, and was not exempted from the gout. About the close of 1776, he was seized with an apoplexy, which left him paralytic; and at the beginning of the year 1777, he suffered another stroke, which very much impaired his mental powers. But the disease supposed to have been the more immediate cause of his death, was an ulceration of the urinary bladder; of which, after a tedious indisposition, he died, January 11. 1778, in the 71st year of his age. —His principal other works, beside those already mentioned, are, The *Iter Oëlandicum et Gotlandicum, Iter Scanicum, Flora Suecica, Fauna Suecica, Materia Medica, Philosophia Botanica, Genera Morborum*, different papers in the *Acta Upsaliensia*, and the *Amœnitates Academicæ.* The last of this great man's treatises was the *Mantissa Altera*, published in 1771; but before his death he had finished the greatest part of the *Mantissa Tertia*, afterwards completed and published by his son.

To the lovers of science it will not appear strange, nor will it be unpleasant to hear, that uncommon respect was shown to the memory of this great man. We are told, "that on his death a general mourning took place at Upsal, and that his funeral procession was attended by the whole university, as well professors as students, and the pall supported by sixteen doctors of physic, all of whom had been his pupils." The king of Sweden, after the death of Linnæus, ordered a medal to be struck, of which one side exhibits Linnæus's bust and name, and the other Cybele, in a dejected attitude, holding in her left hand a key, and surrounded with animals and growing plants; with this legend, *Deam luctus angit amissi;* and beneath, *Post Obitum Upsaliæ, die* x. *Jan.* M.DCC.LXXVIII. *Rege jubente.*—The same generous monarch not only honoured the Royal Academy of Sciences with his presence when Linnæus's commemoration was held at Stockholm, but, as a still higher tribute, in his speech from the throne to the assembly of the states, he lamented Sweden's loss by his death. Nor was Linnæus honoured only in his own country. The late worthy professor of botany at Edinburgh, Dr Hope, not only pronounced an eulogium in honour of him before his students at the opening of his lectures in the spring 1778, but also laid the foundation stone of a monument (which he afterwards erected) to his memory, in the botanic garden there; which, while it perpetuates the name and merits of Linnæus, will do honour to the founder, and, it may be hoped, prove the means of raising an emulation favourable to that science which this illustrious Swede so highly dignified and improved.

As to the private and personal character of this illustrious philosopher: His stature was diminutive and puny; his head large, and its hinder part very high; his look was ardent, piercing, and apt to daunt the beholder; his ear not sensible to music; his temper quick, but easily appeased.

Nature had, in an eminent manner, been liberal in the endowments of his mind. He seems to have been possessed of a lively imagination, corrected however by a strong judgement, and guided by the laws of system. Add to these, the most retentive memory, an unremitting industry, and the greatest perseverance in all his pursuits; as is evident from that continued vigour with which he prosecuted the design, that he appears to have formed so early in life, of totally reforming and fabricating anew the whole science of natural history; and this fabric he raised, and gave to it a degree of perfection unknown before; and had moreover the uncommon felicity of living to see his own structure rise above all others, notwithstanding every discouragement its author at first laboured under, and the opposition it afterwards met with. Neither has any writer more cautiously avoided that common error of building his own fame on the ruin of another man's. He everywhere acknowledged the several merits of each author's system; and no man appears to have been more sensible of the partial defects of his own. Those anomalies which had principally been the objects of criticism, he well knew every artificial arrangement must abound with; and having laid it down as a firm maxim, that every system must finally rest on its intrinsic merit, he willingly commits his own to the judgement of posterity. Perhaps there is no circumstance of Linnæus's life which shows him in a more dignified light than his conduct towards his opponents. Disavowing controversy, and justly considering it as an unimportant and fruitless sacrifice of time, he never replied to any, numerous as they were at one season.

To all who see the aid this extraordinary man has brought to natural science, his talents must appear in a very illustrious point of view; but more especially to those who, from similarity of tastes, are qualified to see more distinctly the vast extent of his original design, the greatness of his labour, and the elaborate execution he has given to the whole. He had a happy command

mand of the Latin tongue, which is alone the language of fcience; and no man ever applied it more fuccefsfully to his purpofes, or gave to defcription fuch copioufnefs, united with that precifion and concifenefs which fo eminently characterize his writings.

The ardour of Linnæus's inclinations to the ftudy of nature, from his earlieft years, and that uncommon application which he beftowed upon it, gave him a moft comprehenfive view both of its pleafures and ufefulnefs, at the fame time that it opened to him a wide field hitherto but little cultivated, efpecially in his own country. Hence he was early led to regret, that the ftudy of natural hiftory, as a public inftitution, had not made its way into the univerfities; in many of which, logical difputations and metaphyfical theories had too long prevailed, to the exclufion of more ufeful fcience. Availing himfelf therefore of the advantages which he derived from a large fhare of eloquence, and an animated ftyle, he never failed to difplay, in a lively and convincing manner, the relation this ftudy hath to the public good; to incite the great to countenance and protect it; to encourage and allure youth into its purfuits, by opening its manifold fources of pleafure to their view, and fhowing them how greatly this agreeable employment would add, in a variety of inftances, both to their comfort and emolument. His extenfive view of natural hiftory, as connected with almoft all the arts of life, did not allow him to confine thefe motives and incitements to thofe only who were defigned for the practice of phyfic. He alfo laboured to infpire the great and opulent with a tafte for this ftudy; and wifhed particularly that fuch as were devoted to an ecclefiaftic life fhould fhare a portion of natural fcience; not only as a means of fweetening their rural fituation, confined, as many are, perpetually to a country refidence, but as what would almoft inevitably lead, in a variety of inftances, to difcoveries which only fuch fituations could give rife to, and which the learned in great cities could have no opportunities to make. Not to add, that the mutual communication and enlargement of this kind of knowledge among people of equal rank in a country fituation, muft prove one of the ftrongeft bonds of union and friendfhip, and contribute, in a much higher degree than the ufual perifhing amufements of the age, to the pleafures and advantage of fociety.

Linnæus lived to enjoy the fruit of his own labour in an uncommon degree. Natural hiftory raifed itfelf in Sweden, under his culture to a ftate of perfection unknown elfewhere; and was from thence diffeminated through all Europe. His pupils difperfed themfelves all over the globe; and, with their mafter's fame, extended both fcience and their own. More than this he lived to fee the fovereigns of Europe eftablifh feveral public inftitutions in favour of this ftudy; and even profefforfhips eftablifhed in divers univerfities for the fame purpofe, which do honour to their founders and patrons, and which have excited a curiofity for the fcience, and a fenfe of its worth, that cannot fail to further its progrefs, and in time raife it to that rank which it is entitled to hold among the purfuits of mankind.

LINNET. See Fringilla, Ornithology *Index*.

LINSEED, the feed of the plant linum.—Linfeed fteeped and bruifed in water gives it very foon a thick mucilaginous nature, and communicates much of its emollient virtue to it. See Linum.

LINT. See Flax; Linen; and Linum, Botany *Index*.

Lint, in *Surgery*, is the fcrapings of fine linen, ufed by furgeons in dreffing wounds. It is made into various forms, which acquire different names according to the difference of the figures.—Lint made up in an oval or orbicular form is called a *pledgit;* if in a cylindrical form, or in fhape of a date, or olive-ftone, it is called a *doffil*.

Thefe different forms of lint are required for many purpofes; as, 1. To ftop blood in frefh wounds, by filling them up with dry lint before the application of a bandage: though, if fcraped lint be not at hand, a piece of fine linen may be torn into fmall rags, and applied in the fame manner. In very large hæmorrhages the lint or rags fhould be firft dipped in fome ftyptic liquor, as alcohol, or oil of turpentine; or fprinkled with fome ftyptic powder. 2. To agglutinate or heal wounds; to which end lint is very ferviceable, if fpread with fome digeftive ointment, balfam, or vulnerary liquor. 3. In drying up wounds and ulcers, and forwarding the formation of a cicatrix. 4. In keeping the lips of wounds at a proper diftance, that they may not haftily unite before the bottom is well digefted and healed. 5. They are highly neceffary to preferve wounds from the injuries of the air.—Surgeons of former ages formed compreffes of fponge, wool, feathers, or cotton; linen being fcarce: but lint is far preferable to all thefe, and is at prefent univerfally ufed.

LINTERNUM, or Literum, in *Ancient Geography*, a city of Campania, fituated at the mouth of the Clanius, which is alfo called Liturnus, between Cumæ and Vulturnum. It received a Roman colony at the fame time with Puteoli and Vulturnum; was improved and enlarged by Auguftus; afterwards forfeited its right of colonyfhip, and became a prefecture. Hither Scipio Africanus the Elder retired from the mean envy of his ungrateful countrymen; and here he died, and was buried: though this laft is uncertain, he having a monument both here and at Rome. No veftige of the place now remains.

LINTSTOCK, in military affairs, a wooden ftaff about three feet long, having a fharp point in one end and a fort of fork or crotch on the other; the latter of which ferves to contain a lighted match, and by the former the lintftock is occafionally ftuck in the ground, or in the deck of a fhip during an engagement. It is very frequently ufed in fmall veffels, where there is commonly one fixed between every two guns, by which the match is always kept dry, and ready for firing.

LINTZ, a very handfome town of Germany, and capital of Upper Auftria, with two fortified caftles; the one upon a hill, the other below it. Here is a hall in which the ftates affemble, a bridge over the Danube, a manufacture of gunpowder, and feveral other articles. It was taken by the French in 1741, but the Auftrians retook it in the following year. E. Long. 14. 33. N. Lat. 48. 16.

Lintz, a town of Germany, in the circle of the Lower Rhine, and electorate of Cologne, fubject to that

that elector. It is seated on the river Rhine, in E. Long. 7. 1. N. Lat. 50. 31.

LINUM, FLAX; a genus of plants belonging to the pentandria class; and in the natural method ranking under the 14th order, *Gruinales*. See BOTANY *Index*.

LINUS, in classical history, a native of Colchis, cotemporary with Orpheus, and one of the most ancient poets and musicians of Greece. It is impossible, at this distance of time, to discover whether Linus was the disciple of Orpheus, or Orpheus of Linus. The majority, however, seem to decide this question in favour of Linus. According to Archbishop Usher, he flourished about 1280 B. C. and he is mentioned by Eusebius among the poets who wrote before the time of Moses. Diodorus Siculus tells us, from Dionysius of Mitylene the historian, who was cotemporary with Cicero, that Linus was the first among the Greeks who invented verses and music, as Cadmus first taught them the use of letters. The same writer likewise attributes to him an account of the exploits of the first Bacchus, and a treatise upon Greek mythology, written in Pelasgian characters, which were also those used by Orpheus, and by Pronapides the preceptor of Homer. Diodorus says that he added the string *lichanos* to the Mercurian lyre; and ascribes to him the invention of rhime and melody; which Suidas, who regards him as the most ancient of lyric poets, confirms. Mr Marpurg tells us, that Linus invented cat-gut strings for the use of the lyre, which, before his time, was only strung with thongs of leather, or with different threads of flax strung together. He is said by many writers to have had several disciples of great renown; among whom were Hercules, Thamyris, and, according to some, Orpheus.—Hercules, says Diodorus, in learning from Linus to play upon the lyre, being extremely dull and obstinate, provoked his master to strike him; which so enraged the young hero, that, instantly seizing the lyre of the musician, he beat out his brains with his own instrument.

LION, in *Zoology*. See FELIS, MAMMALIA *Index*.

LIONCELLES, in *Heraldry*, a term used for several lions borne in the same coat of arms.

LIOTARD, called the *Turk*, an eminent painter, was born at Geneva in 1702, and by his father was designed for a merchant; but, by the persuasion of his friends, who observed the genius of the young man, he was permitted to give himself up to the art of painting. He went to Paris in 1725, and in 1738 accompanied the marquis de Puisieux to Rome, who was going ambassador to Naples. At Rome he was taken notice of by the earls of Sandwich and Besborough, then Lord Duncannon, who engaged Liotard to go with them on a voyage to Constantinople. There he became acquainted with the late Lord Edgecumbe, and Sir Everard Fawkener, our ambassador, who persuaded him to come to England, where he staid two years. In his journey to the Levant he had adopted the eastern habit, and wore it here with a very long beard. It contributed much to the portraits of himself, and some thought to draw customers; but he was really a painter of uncommon merit. After his return to the continent, he married a young wife, and sacrificed his beard to Hymen. He came again to England in 1772, and brought a collection of pictures of different masters, which he sold by auction, and some pieces of glass painted by himself, with surprising effect of light and shade, but a mere curiosity, as it was necessary to darken the room before they could be seen to advantage; he affixed, too, as usual, extravagant prices to them. He staid here about two years, as in his former journey. He has engraved some Turkish portraits, one of the empress queen and the eldest archduchess in Turkish habits, and the heads of the emperor and empress. He painted admirably well in miniature; and finely in enamel, though he seldom practised it. But he is best known by his works in crayons. His likenesses were as exact as possible, and too like to please those who sat to him; thus he had great business the first year, and very little the second. Devoid of imagination, and one would think of memory, he could render nothing but what he saw before his eyes. Freckles, marks of the smallpox, every thing found its place; not so much from fidelity, as because he could not conceive the absence of any thing that appeared to him. Truth prevailed in all his works, grace in very few or none. Nor was there any ease in his outline; but the stiffness of a bust in all his portraits. *Walpole*.

LIP, in *Anatomy*. See there, N° 102.

Hare-Lip, a disorder in which the upper lip is in a manner slit or divided, so as to resemble the upper lip of a hare, whence the name. See SURGERY.

LIPARA, in *Ancient Geography*, the principal of the islands called *Æolia*, situated between Sicily and Italy, with a cognominal town, so powerful as to have a fleet, and the other islands in subjection to it. According to Diodorus Siculus, it was famous for excellent harbours and medicinal waters. He informs us also, that it suddenly emerged from the sea about the time of Hannibal's death. The name is Punic, according to Bochart: and given it, because, being a volcano, it shone in the night. It is now called *Lipari*, and gives name to nine others in its neighbourhood; viz. Stromboli, Pare, Rotto, Panaria, Saline, Volcano, Fenicusa, Alicor, and Ustica. These are called, in general, the *Lipari Islands*. Some of these are active volcanoes at present, though Lipari is not. It is about 15 miles in circumference; and abounds in corn, figs and grapes, bitumen, sulphur, alum, and mineral waters.

LIPARI, an ancient and very strong town, and capital of an island of the same name in the Mediterranean, with a bishop's see. It was ruined by Barbarossa in 1544, who carried away all the inhabitants into slavery, and demolished the place; but it was rebuilt by Charles V. E. Long. 15. 30. N. Lat. 38. 35.

LIPARI, properly, is the general name of a cluster of islands. These, according to Mr Houel, are principally ten in number, the rest being only uninhabitable rocks of narrow extent. The largest and the most populous of them, that above mentioned, communicates its name to the rest. *Volcano* is a desert but habitable island, lying south from the large island of Lipari. *Salines*, which lies west-north-west from the same island; *Felicudi*, nearly in the same direction, but 20 miles farther distant; and *Alicudi*, 10 miles south-west of Felicudi; are inhabited. *Pannari* is east of Lipari, the famous *Stromboli* north-east, and both of them are inhabited. The

Lipari. The reſt are in a deſert ſtate; ſuch as *Baziluzzo*, which was formerly inhabited; *Attalo*, which might be inhabited; and *L'Exambianca*, on which ſome remains of ancient dwellings are ſtill to be found. *L'Eſcanera* is nothing but a bare rock.

The *Fermicoli*, a word ſignifying *ants*, are a chain of ſmall black cliffs which run to the north-eaſt of Lipari, till within a little way of Exambianca and Eſcanera, riſing more or leſs above the water, according as the ſea is more or leſs agitated.

Ancient authors are not agreed with reſpect to the number of the Lipari iſlands. Few of thoſe by whom they are mentioned appear to have ſeen them; and in places ſuch as theſe, where ſubterraneous fires burſt open the earth and raiſe the ocean from its bed, terrible changes muſt ſometimes take place. *Volcanello* and *Volcano* were once ſeparated by a ſtrait ſo as to form two iſlands. The lava and aſhes have filled up the intervening ſtrait; and they are now united into one iſland, and have by this change become much more habitable.

The caſtle of Lipari ſtands upon a rock on the eaſt quarter of the iſland. The way to it from the city leads up a gentle declivity. There are ſeveral roads to it. This caſtle makes a part of the city; and on the ſummit of the rock is the citadel, in which the governor and the garriſon reſide. The cathedral ſtands in the ſame ſituation. Here the ancients, in conformity to their uſual practice, had built the temple of a tutelary god. This citadel commands the whole city; and it is acceſſible only at one place. Were an hoſtile force to make a deſcent on the iſland, the inhabitants might retreat hither, and be ſecure againſt all but the attacks of famine.

The ancient inhabitants had alſo fortified this place. Conſiderable portions of the ancient walls are ſtill ſtanding in different places, particularly towards the ſouth: Their ſtructure is Grecian; and the ſtones are exceedingly large, and very well cut. The layers are three feet high, which ſhows them to have been raiſed in ſome very remote period. Theſe remains are ſurrounded with modern buildings. The remains of walls, which are ſtill to be ſeen here, have belonged not only to temples, but to all the different ſorts of buildings which the ancients uſed to erect. The vaults, which are in a better ſtate of preſervation than any of the other parts of theſe monuments, are now converted to the purpoſes of a priſon.

In the city of Lipari there are convents of monks of two different orders; but there are no convents for women, that is to ſay, no cloiſters in which women are confined; thoſe, however, whoſe heads and hearts move them to embrace a ſtate of pious celibacy, are at liberty to engage in a monaſtic life, with the concurrence of their confeſſors. They put on the ſacred habit, and vow perpetual virginity, but continue to live with their father and mother, and mix in ſociety like other women. The vow and the habit even enlarge their liberty. This cuſtom will, no doubt, M. Houel obſerves, appear very ſtrange to a French woman; but this was the way in which the virgins of the primitive church lived. The idea of ſhutting them up together did not occur till the fifth century. The life of theſe religious ladies is leſs gloomy than that which thoſe under the ſame vows lead in other countries. They wear clothes of particular colours, according as they belong to this or that order. Their dreſs gives them a right to frequent the churches at any hours; and the voice of cenſure, which takes particular pleaſure in directing her attacks againſt pious ladies, goes ſo far as to aſſert, that ſome young women aſſume the habit with no other views but that they may enjoy greater freedom.

In this iſland oxen of a remarkably beautiful ſpecies are employed in ploughing the ground. The ancient plough is ſtill in uſe here. The mode of agriculture practiſed here is very expeditious. One man traces a furrow, and another follows to ſow in it grain and pulſe. The ploughman, in cutting the next furrow, covers up that in which the ſeed has been ſown: and thus the field is both ploughed and ſown at once. Nature ſeems to be here uncommonly vigorous and fertile. Vegetation is here more luxuriant, and animals gayer and more healthful, than almoſt anywhere elſe.

Near the city of Lipari, the traveller enters deep narrow roads, of a very ſingular appearance. The whole iſland is nothing but an aſſemblage of mountains, all of them conſiſting of aſhes or lava diſcharged from the depths of the volcano by which it was at firſt produced. The particles of this puzzolana, or aſhes, are not very hard; the action of the rain water has accordingly cut out trenches among the mountains; and theſe trenches being perhaps leſs uneven than the reſt of the ſurface, have of conſequence been uſed as roads by the inhabitants, and have been rendered much deeper by being worn for ſo many ages by the feet of men and other animals. Theſe roads are more than five or ſix fathoms deep, and not more than ſeven or eight feet wide. They are very crooked, and have echoes in ſeveral places. You would think that you were walking through narrow ſtreets without doors or windows. Their depth and windings ſhelter the traveller from the ſun while he is paſſing through them; and he finds them deliciouſly cool.

The firſt volcanic eruption in the Lipari iſlands mentioned in hiſtory, is that of which Callias takes notice in his hiſtory of the wars in Sicily. Callias was contemporary with Agathocles. That eruption continued without interval for ſeveral days and nights; and threw out great ſtones, which fell at more than a mile's diſtance. The ſea boiled all around the iſland. The works of Callias are loſt, and we know not whether he deſcended to a detail of particulars concerning the ravages produced by this eruption. Under the conſulſhip of Æmilius Lepidus and L. Aurelius Oreſtes, 126 years before the Chriſtian era, theſe iſlands were affected with a dreadful earthquake. The burning of Ætna was the firſt cauſe of that. Around Lipari and the adjacent iſlands, the air was all on fire. Vegetation was withered; animals died; and fuſible bodies, ſuch as wax and reſin, became liquid. If the inhabitants of Lipari, from whom our author received theſe facts, and the writers who have handed down an account of them, have not exaggerated the truth, we muſt believe that the ſea then boiled around the iſland; the earth became ſo hot as to burn the cables by which veſſels were fixed to the ſhore, and conſumed the planks, the oars, and even the ſmall boats.

Pliny, the naturaliſt *, ſpeaks of another ſimilar event which happened 30 or 40 years afterwards, in the

* Lib. ii. cap. 106.

Lipari. the time of the war of the allied ſtates of Italy againſt Rome. One of the Æolian iſlands, ſays he, was all on fire as well as the ſea; and that prodigy continued to appear, till the ſenate appeaſed, by a deputation, the wrath of the gods. From the time of that war, which happened 86 years before the birth of our Saviour, till the year 144 of our era, we have no account of any eruption of theſe volcanoes: and from that period again, till the year 1444, we hear of no exploſion from them, that is, for the ſpace of 1300 years. But, at that time, both Sicily and the Æolian iſles were agitated by dreadful ſhocks of earthquakes: the volcano of theſe iſles poured forth ſtreams of lava with an awful violence, and emitted a volume of flame and ſmoke which roſe to an amazing height. After that it diſcharged enormous ſtones which fell at the diſtance of more than ſix miles.

A century later, in the year 1550, the fury of this volcano was again renewed. The aſhes and ſtones diſcharged from the crater filled up the ſtrait between Volcano and Volcanello.

About two centuries after that, in the year 1739, there was a ſixth eruption. The burſtings of the volcanic fire were attended with a noiſe ſo dreadful, that it was heard as far as Melazzo in Sicily.

Father Leandro Alberti ſays, that on one of thoſe dreadful occaſions, the women of Lipari, after imploring in vain all the ſaints, vowed to drink no more wine if the volcano ſhoud ſpare them. Their giving up this ſmall gratification was doubtleſs of great ſervice; yet the eruptions ſtill continue, and have even become more frequent ſince that time. Only 36 years intervened between this eruption and that which happened in the year 1775. The whole iſland was then ſhaken; ſubterraneous thunder was heard; and conſiderable ſtreams of flame, with ſmoke, ſtones, and vitreous lava, iſſued from the crater. Lipari was covered over with aſhes; and part of theſe was conveyed by the winds all the way into Sicily. Five years after, however, in the month of April 1780, there iſſued a new exploſion from Volcano; the ſmoke was thick, the ſhocks conſtant, and the ſubterraneous noiſe very frequent. So great was the conſternation among the inhabitants of Lipari on this occaſion, that the commander Deodati Dolomieu, who viſited theſe iſlands not long after that event, informs us, that the inhabitants in general, but eſpecially the women, devoted themſelves as ſlaves to the ſervice of the bleſſed virgin; and wore on their arms, as tokens of their ſervitude, ſmall iron chains, which they ſtill continue to wear.

This act of piety, however, was not ſo efficacious as the deputation of the ſenate had been. For after that deputation, more than 200 years paſſed before the Æolian iſles were afflicted by any other eruption, at leaſt by any conſiderable one: Whereas, in three years after the ladies devoted themſelves in ſo ſubmiſſive a manner to the ſervice of the virgin, the iſles of Lipari were agitated anew by that fatal earthquake which ravaged Calabria, and part of Sicilly, on the 5th of February 1783.

The dry baths of St Calogero, in the iſland of Lipari, are ſtoves, where ſulphureous exhalations, known to be of a ſalutary nature, aſcend out of the earth by holes or ſpiracles. A range of apartments are built around the place where the exhalations ariſe. The heat is communicated through thoſe apartments, in ſuch a way, that when entering at one end, you advance towards the other, the heat ſtill increaſes upon you till you gain the middle apartment, and again diminiſhes in the ſame manner as you proceed from the middle to the other end of the range of chambers. In conſequence of this diſpoſition of theſe apartments, the ſick perſon can make choice of that temperature which beſt ſuits the nature of his diſeaſe. There are a few miſerable huts and a ſmall chapel for the accommodation of the people who repair to theſe baths. The people of the place are ready to attend them. Phyſicians likewiſe follow their patients thither, when the diſeaſe is of ſuch a nature as to render their attendance requiſite, and the patient rich enough to afford them handſome fees: but there is no phyſician ſettled in the place. Beſides theſe dry baths, there are baths of hot water diſtinguiſhed by the name of *St Calogero's baths*. There are around them buildings ſufficient to lodge a conſiderable number of ſick people with their neceſſary attendants. At preſent, however, thoſe buildings are but in a bad condition.

The baths conſiſt of two halls; one ſquare, the other round. The former is antique; it has been built by the Romans; it is arched with a cupola, and 12 feet in diameter; it has been repaired: The other is likewiſe arched with a cupola both within and without. The water comes very hot into the firſt. It guſhes up from among pieces of lava, which compoſe a part of the mountain at the foot of which theſe baths are built. Thoſe ſtones remain in their natural ſtate. All that has been done is the raiſing of a ſquare building encloſing them. Within that building the ſick perſons either ſit down on the ſtones, or immerſe themſelves in the intervening cavities which are filled with water. They continue there for a certain time, and approach nearer to, or remain at a farther diſtance from the ſpring, according as their phyſician directs. The place ſerves alſo as a ſtove. The hot vapours ariſing from the water communicate to the ſurrounding atmoſphere a conſiderable degree of heat. It is indeed not inferior to that of the hot baths of Termini, which owe their heat to a ſimilar cauſe. In theſe baths, therefore, a perſon can have the benefit either of bathing in the hot water, or of expoſing himſelf to the vapour, the heat of which is more moderate. The bath before mentioned, under the appellation of *dry bath*, is alſo a ſtove; but the hot vapour with which it is filled iſſues directly from the volcano. The place of the bath is, however, at ſuch a diſtance from the volcanic focus, that the heat is not at all intolerable.

The mountain at the foot of which theſe baths are ſituated is round, and terminates at the ſummit in a rock of petrified aſhes, which are very hard and of a very fine grain. This petrification conſiſts of pretty regular ſtrata, and appears to have been greatly prior in its origin to the adjacent rocks; which conſiſt likewiſe of aſhes, but aſhes that have been depoſited at a much later period. From this rock there proceeds likewiſe a ſtream of hot water, by which ſome mills in the neighbourhood are moved.

It cannot but appear ſurpriſing, that nature has placed nearly on the ſummit of a volcanic mountain ſprings

springs which supply so considerable a quantity of water. To account for such a phenomenon would be well worthy of some ingenious naturalist. Nor are these hot springs all; proceeding around the same hill, at about a mile's distance, we find a spring of cold water rising from the summit of the same rock, which on the north-west produces three hot springs. The cold water is very pleasant to drink, and much used both by men and cattle.

Among these mountains there are many enormous loose masses of lava, the appearance of which, M. Houel informs us, naturally leads the observer to take notice, that the lava of the volcano of Lipari is of a much greater diversity of colours, and those richer and more lively, than the lava of Vesuvius and Ætna. The lava of Lipari is in some places, for several miles, of a beautiful red colour. It contains likewise in great abundance small black crystallized scoriæ, as well as the small white grains which are commonly found in lava.

Among the eminences which overlook the city of Lipari, there are some rocks of a species which is very rare in Europe. These are large masses of vitrified matter, which rise six or eight feet above the surface of the ground, and appear to extend to a great depth under it. They exist, through that range of mountains, in enormous masses, mixed with lavas of every different colour, and always standing detached and insulated. Were they cut and followed under ground, they would probably be found to exist in immense quarries in the bowels of the earth. The glass of which they consist might be employed with great advantage in manufactures. It is ready made, and might be easily purified. It is green, compact, and transparent.

The cultivation of the ground is the chief employment of the inhabitants of Lipari. The possession of a few acres of land here gives a man great importance. Parents, when they settle their children, rather give them money than any part of their lands.

More than two-thirds of the island is planted with vines: three-fourths of the grapes which these produce are dried, and sent mostly to London under the name of *passola*. There are different sorts of passola: one of these, called the *black passolina*, is prepared from a particular kind of grape, of which the berries are uncommonly small; and sold to Marseilles, Holland, and Trieste. The vines are in small arbours, which rise only to the height of two feet and a half above the ground. Under those arbours there grow beans, gourds, and other leguminous vegetables. In so hot a climate, the shade of the vines does not injure but protect the vegetables growing under it: they would otherwise be withered by the heat of the sun.

The method of preparing passola and passolina is curious enough: They first make a lixivium of common ashes; after boiling this, they pass it through a cloth or a sieve; they then put it again on the fire; and when it is observed to boil hard, suddenly immerse the grapes, but instantly bring them out again, and expose them to the sun to dry on broad frames of cane. When sufficiently dry, the raisins are put into casks and barrels to be sold and exported. The number of casks of different sorts of raisins annually exported from Lipari are estimated at 10,000.

This island likewise produces figs. There is some white malmsey and a little red wine exported from it.

About 60 or 80 years since, sulphur was one of the articles with which the inhabitants of this island supplied foreign merchants. But that trade has been given up; from an idea which the Liparese entertain, that sulphur infects the air so as to injure the fertility of the vines. The same prejudice prevails in Sicily, but it seems to be ill founded.

There are courts of justice in Lipari of the same powers and character with those in the cities of Sicily. Causes of more than ordinary importance are carried to Palermo.

The island is entirely free from every kind of imposition. The king receives nothing from it; because Count Roger anciently bestowed on its bishop all his rights of royalty over Lipari. The bishop there received annually from the inhabitants a tenth part of the products of their lands. They afterwards, to prevent fraud, estimated the value of that tithe for one year; and on the condition of their paying in future a sum of money equal to what that year's tithe was valued at, he not only gave up his right to the tithe, but also ceded to them a considerable extent of land which belonged to him.

In the archiepiscopal palace, and in the palace of the Baron de Monizzio, there are some noble pieces of painting by Sicilian painters:—A St Peter, a St Rosalia, Jesus disputing with the Jewish doctors, the adulterous woman, the incredulity of St Thomas.

LIPOTHYMIA, FAINTING, may arise from several causes; as too violent exercise, suppression of the menses or other accustomed evacuations, &c. See MEDICINE *Index*.

LIPPA, a town of Hungary, with a castle. It was taken by the Turks in 1552; by the Imperialists in 1688; and by the Turks again in 1691; who abandoned it in 1675; after having demolished the fortifications. It is seated on a mountain, in E. Long. 21. 55. N. Lat. 36. 5.

LIPPE, the capital of a county of the same name in Germany, and the circle of Westphalia. It is seated on a river of the same name, and was formerly the residence of the principal branch of the house of Lippe. It is now in the possession of the king of Prussia, and carries on a good trade in preparing timber for building vessels on the Rhine, with which it has a communication by the river Lippe. The country round it is unwholesome and marshy. E. Long. 8. 12. N. Lat. 51. 43.

LIPPI, LORENZO, a painter of history and portraits, was born in 1606, and learned the principles of painting from Matteo Roselli. He had an exquisite genius for music and poetry, as well as for painting, and in the latter his proficiency was so great, that some of his compositions in the historical style were taken for those of Roselli. However, growing at last dissatisfied with the manner of that master, he chose the manner of Santi di Titi, who was excellent both in design and invention, and appeared to have more of simple nature and truth in his compositions than any other artist of that time. At Florence Lippi painted many grand designs for the chapels and convents, by which he enlarged his reputation; and at the court of Inspruck, he painted a great number of portraits of the first nobility,

bility, which were deservedly admired. Yet, although he was fond of imitating simple nature without any embellishments from invention, his works are held in the highest esteem for the graceful airs of the heads, for the correctness of his outline, and for the elegant disposition of the figures. He died in 1664.

LIPSIUS, Justus, a learned critic, was born at Isch, a small village near Brussels, in 1547. After having distinguished himself in polite literature, he became secretary to Cardinal de Granvellan at Rome, where the best libraries were open to him; and he spent much labour in collating the MSS. of ancient authors. He lived 13 years at Leyden; during which he composed and published what he esteems his best works; but settled at Louvain, where he taught polite literature with great reputation. He was remarkable for unsteadiness in religion, fluctuating often between the Protestants and Papists; but he became finally a bigotted catholic. He died at Louvain in 1606; and his works are collected in six volumes folio.

LIQUEFACTION, an operation by which a solid body is reduced into a liquid by the action of heat. See Fluidity, Chemistry *Index*.

LIQUID, a body which has the property of fluidity, as water, mercury, &c. See Fluid.

Liquid, among grammarians, is a name applied to certain consonants opposed to mutes. Thus l, m, n, and r, are liquids.

LIQUIDAMBAR, sweet-gum-tree, a genus of plants, belonging to the monœcia class; and in the natural method ranking with those of which the order is doubtful. See Botany *Index*.

LIQUOR, a name for any fluid substance of the aqueous or spirituous kind.

The principal beverage amongst the Jews, as well as the Greeks and Romans, in their early state, was water, milk, and the juices of various plants infused therein. For a long time, under the commonwealth of Rome, wine was so scarce, that in their sacrifices to the gods the libations were made with milk only. Wine did not become common there till A. U. C. 600, when vines began to be planted.

Liquor of Flints. See Chemistry, N° 1450.

Smoking Liquor of Libavius. See Chemistry, N° 1809.

Mineral Anodyne Liquor of Hoffman. This is a composition of highly rectified spirit of wine, vitriolic ether, and a little of the dulcified oil of vitriol. See Chemistry, N° 849.

LIQUORICE. See Glycyrrhiza, Botany and Materia Medica *Index*.

LIRIODENDRON, the tulip tree, a genus of plants belonging to the polyandria class, and in the natural method ranking under the 52d order, *Coadunatæ*. See Botany *Index*.

LIS or Lys, *John Vander*, painter of history, landscapes, and conversations, was born at Oldenburgh in 1570, but went to Haerlem to place himself as a disciple under Henry Goltzius; and as he was endowed with great natural talents, he soon distinguished himself in that school, and imitated the manner of his master with great success. He adhered to the same style till he went to Italy; where, having visited Venice and Rome, he studied the works of Titian, Tintoretto, Paolo Veronese, and Domenico Fetti, so effectually, that he improved his taste and judgement, and altered his manner entirely. He soon received marks of public approbation; and his compositions became universally admired for their good expression, for their lively and natural colouring, and the sweetness and delicacy of his pencil: although it must be acknowledged, that he could never totally divest himself of the ideas and taste peculiar to the Flemings. His subjects usually were histories taken from the sacred writings, or the representations of rural sports, marriages, balls, and villagers dancing, dressed in Venetian habits; all which subjects he painted in a small as well as a large size, with a number of figures, well designed, and touched with a great deal of delicacy. He was likewise accounted to paint naked figures admirably, with natural and elegant attitudes, and a very agreeable turn of the limbs. A capital picture of this master is, Adam and Eve lamenting the death of Abel; which is extremely admired, not only for the expression, but also for the beauty of the landscape: and in the church of St Nicholas at Venice is another of his paintings, representing St Jerome in the desert, with a pen in his hand, and his head turned to look at an angel, who is supposed to be sounding the last trumpet. The colouring of this picture is rather too red; but it is designed in a fine style, and charmingly penciled. The paintings of this master are very rarely to be purchased. He died in 1629.

Lis, *John Vander*, of Breda, historical painter, was born at Breda about the year 1601, and became a disciple of Cornelius Polemburg, whose manner he imitated with extraordinary exactness, in the tint of his colouring, his neatness of penciling, and the choice of his subjects. There are some paintings of this master's hand, which, though they appear to have somewhat less freedom and lightness of touch, are nearly equal to those of Polemburg, and are frequently taken to be his. At Rotterdam, in the possession of Mr Bisschop, there is a delicate painting representing Diana in the bath, attended by her nymphs; and his most capital performance, in England, is said to be in the possession of the viscount Middleton. The portrait of Vander Lis, painted by himself, is in the possession of Horace Walpole, Esq. which is described by that ingenious gentleman, as being worked up equal to the smoothness of enamel.

LISBON, the capital of the kingdom of Portugal, situated in the province of Estremadura, on the banks of the river Tagus, in W. Long. 9. 25. N. Lat. 38. 25. It was anciently called *Olisipo*, *Olisippo*, and *Ulyssipo*, which are supposed to be derived from the Phenician *Ulisubbo* or *Olisippo*, signifying in that tongue a *pleasant bay*, such as that on which this city stands. It first became considerable in the reign of King Emmanuel; from that time it has been the capital of the kingdom, the residence of its monarchs, the seat of the chief tribunals, and offices of the metropolitans, a noble university, and the receptacle of the richest merchandise of the East and West Indies. Its air is excellent; being refreshed by the delightful sea breezes, and those of the Tagus. The city extends for about two miles along the Tagus; but its breadth is inconsiderable. Like old Rome, it stands on seven hills: but the streets in general are narrow and dirty, and some of them are very steep: neither are they lighted at night. The churches, in general, are very fine; but the magnificence of the

chapel

chapel royal is amazing. Here is one of the finest harbours in the world; and there were a great number not only of fine churches and convents here, but also of other public buildings, and particularly of royal palaces, and others belonging to the grandees; but the greatest part of them, and of the city, were destroyed by a most dreadful earthquake, on Nov. 1. 1755. from which it will require a long time to recover. The inhabitants, before the earthquake, did not at most exceed 150,000. The government of it is lodged in a council, consisting of a president, six counsellors, and other inferior officers. The harbour has water enough for the largest ships, and room enough for 10,000 sail without being crowded. For its security, there is a fort at the mouth of the river, on each side, and a bar that runs across it, and is very dangerous to pass without pilots. Higher up, at a place where the river is considerably contracted, there is a fort called *Torre de Belem*, or the *Tower of Belem*, under whose guns all ships must pass in their way to the city; and on the other side are several more forts. Before the earthquake, most of the private houses were old and unsightly, with lattice windows; and the number of convents and colleges amounted to 50, namely, 32 for monks, and 18 for nuns. The king's principal palace stands on the river, and is large and commodious. Of the hospitals, that called the *Great* is obliged to receive all persons, of what degree, nation, or religion soever, without exception. At the village of Belem, near Lisbon, is a noble hospital for decayed gentlemen who have served the king, and have not wherewithal to maintain themselves. That called the *House of Mercy* is also a noble charity. In the centre of the city, upon one of the highest hills, is the castle, which commands the whole, being large and ancient, and having always a garrison of four regiments of foot. The cathedral is a vast edifice of the Gothic kind, but heavy and clumsy: it contains, however, great riches; and is finely adorned within. The square called *Rossio* is large, and surrounded with magnificent buildings. The whole city is under the ecclesiastical jurisdiction of the patriarch, who was appointed in the year 1717. Here is also an archbishop, who has, or at least had, before the erection of the patriarchate, a revenue of 40,000 crusadoes, or 6000l. The university, which was removed for some time to Coimbra, but afterwards restored to its ancient seat, makes a considerable figure, though much inferior to that of Coimbra.

LISBURN, a town of Ireland, in the county of Antrim and province of Ulster, 73 miles from Dublin. It was burnt down about 50 years ago; but is now rebuilt in a neat and handsome manner, and has a large linen manufactory. It is seated on the river Laggan, in W. Long. 6. 20. N. Lat. 54. 31. It gives title of earl to the family of Vaughan, and formerly returned two members to parliament.

LISIEUX, a considerable town of France, in Upper Normandy, with a bishop's see. The churches and religious houses, and the bishop's palace, are all very handsome structures. It is a trading place; and is seated at the confluence of the rivers Arbeck and Gassi, in E. Long. 0. 20. N. Lat. 49. 11.

LISLE, a large, rich, handsome, and strong town of French Flanders, of which it is the capital, with a strong castle, and a citadel built by Vauban, and said to be the finest in Europe, as well as the best fortified. The largest square, and the public buildings, are very handsome; and they have manufactures of silks, cambrics, and camblets, as well as other stuffs, which have been brought to great perfection. It was taken by the duke of Marlborough, after three months siege and the loss of many thousands of men, in 1708, but restored to the French by the treaty of Utrecht, in consideration of their demolishing the fortifications of Dunkirk. It was besieged by the Austrians in 1792, who on the 29th of September began a heavy cannonading against it, which continued incessant till the 6th of October, when they were obliged to raise the siege, after having thrown into the city about 30,000 red-hot balls, besides 6000 bombs. It is seated on the river Duele, 14 miles west of Tournay, 32 south-west of Ghent, 37 north-west of Mons, and 130 north of Paris. E. Long. 3. 9. N. Lat. 50. 83.

LISLE, *Joseph Nicholas de*, an eminent astronomer and geographer, was born at Paris in the year 1668. His father having taught him the principles of grammar, he afterwards attended lectures in the Mazarine college, where he delivered his rhetorical exercises in 1706. A total eclipse of the sun having taken place on the 12th of March that year, his taste for mathematics was thus discovered, and he was accordingly placed under a proper tutor, who taught him the elements of geometry, fortification and mechanics; but his favourite study was the science of astronomy.

In 1707 he was offered the place of an engineer at Martinico, which made him acquainted with the art of drawing, an acquisition which proved highly useful to him in his geographical labours, and also in the study of astronomy. His father having got a copy of An Account of a Voyage to the South sea from his son's master, young de Lisle was excited by the perusal of it to the study of natural history, and he began to make collections of insects, and sketch their varieties; but being afterwards persuaded that so extensive a study, requiring such immense collections to be made as he found in Aldrovandus, was wholly incompatible with that unremitting attention which his favourite science required, he relinquished it accordingly. The attention he paid to astronomical researches was so great, that he was considered as meriting the correspondence of some of the ablest astronomers of Europe at the early age of 21. In 1709 he made a wooden quadrant, which he divided with the utmost accuracy, and which answered the intended purpose in his early observations. He likewise constructed a table for M. Cassini, of the right ascensions and declinations, adapted to all the degrees of latitude and longitude of the planets, and the obliquity of the ecliptic; this table was made use of by M. Cassini in foretelling the occultations of the stars by the moon.

De Lisle being informed by Cassini in 1710 of his method of representing an eclipse of the sun, by the projection of a terrestrial parallel on a plane; he instantly conceived the idea of applying it to every part of the earth, by means of a globe mounted and prepared for that purpose. Such astronomers as he made acquainted with his project, conceived it to be impracticable; but when the machine was completed, they bestowed the highest encomiums on the noble invention. The first memorable observation made by de Lisle was that of the moon, on the 23d of January 1712, after which his labours experienced some interruption from bodily indisposition. About this time the situation of his father's numerous family rendered it necessary that he should provide for himself, so that he was obliged to make his astronomical knowledge subservient to the absurdities of astrology, receiving pecuniary presents from the regent for his services. He received also in 1715 the grant of a pension of 600 livres, on which occasion he calculated tables of the moon according to the Newtonian theory, prior to Halley's communications to him, which were printed in 1719. De Lisle was chosen a member of the Academy of Sciences in 1714, on which account his exertions were redoubled.

In 1720 he delivered a proposal to the academy for ascertaining in France the figure of the earth, a design which was carried into execution some years afterwards. In 1723 he delivered to the same academy a memoir on the transits of Mercury, wherein a method of calculating them was proposed by him, the way in which they were to be observed, and the inferences to be deduced from these observations. He proposed the use of the quadrant in observing the transits of Venus and Mercury, which has been found superior to any other instrument for that important purpose, and is sanctioned since his day by the practice of the ablest astronomers.

Our distinguished philosopher came over to England in the year 1724, where he became acquainted with Newton and Halley, and had the honour of obtaining their approbation. Newton made him a present of his own portrait, and Halley gave him a copy of the tables which he had published in 1719. He was also created a member of the Royal Society, and he enjoyed similar honours from every literary society in Europe before his death. In 1721 he received an invitation from Peter the Great to go to Petersburgh, to fill the chair of astronomer in the Imperial Academy of Sciences. On the death of that emperor, his successor Catharine renewed the invitation, offering him a considerable pension, of which he accepted, and, in 1726, set out for Petersburgh, accompanied by his brother Lewis and M. Vignon, who were to act as his assistants. He reached Petersburgh in the month of October, and was established in the observatory erected by Peter the Great, which he occupied for 21 years. It was in every respect commodious, but extremely deficient in astronomical apparatus, which his own ingenuity and indefatigable application in a great measure supplied.

A transit of Mercury over the sun's disc was expected in the year 1740, which would not be visible in Europe, and therefore de Lisle undertook a journey to the distant regions of Asia; but after travelling through the inhospitable wilds of Siberia, the cloudiness of the atmosphere prevented him from observing the transit,—a mortification which he endeavoured to support by his geographical and physical remarks, and in drawing up a description of the country. He constructed an interesting map of Russia, assisted by his brother Lewis, who was appointed to make observations in the most distant parts of that immense empire. He was occasionally employed for the long period of forty years, in making meteorological observations, which he executed with an accuracy almost incredible.

After a number of discouragements and difficulties, and the irregular payment of his pension, had been long experienced by de Lisle at Petersburgh, he returned disgusted to his native place, and was chosen professor of mathematics at the college royal, where he did the most essential service to the sciences, by the important instructions which he gave to his numerous pupils, many of whom became afterwards the most distinguished characters, such as M. M. de la Lande and Messier.

When the transit of Mercury over the sun was eagerly expected in 1753 by the greatest astronomers, de Lisle published an interesting map of the world, representing the effect of Mercury's parallaxes in different countries, that such places might be known as were proper for making those observations on the transit as might determine the distance of the sun. As the apparent orbit of the planet traversed nearly the centre of the sun, de Lisle made use of this circumstance to determine the diameter of that luminary. The last work of our author which was inserted in the volumes of the French academy, was a memoir on the comet which appeared in the year 1758, discovered by a peasant in the vicinity of Dresden.

It may perhaps be asserted with justice, that the most important service which this great man rendered to astronomers was, his correction of the double error of Halley respecting the transit of Venus, looked for in the year 1761, as by this means he prevented many learned men from undertaking long voyages in order to observe it. About the year 1754, de Lisle was appointed by the king of France, astronomical geographer to the marine, in which capacity he was to collect plans and journals of naval captains, to arrange them methodically, and to make extracts from them of whatever might be beneficial to the service. About the year 1758 he withdrew into quiet retirement at the abbey of St Genevieve, where much of his time was spent in devotional exercises, and in acts of charity and beneficence. Still, however, he continued to prosecute those studies which had been so dear to him during the earlier part of his life; but in 1768 he was seized with a scorbutic complaint, of which he was cured by his medical friends; but in the month of September the same year he was seized with a species of apoplexy, which carried him off on the 11th day of that month, in the 81st year of his age.

His extraordinary merit as a man of science may in in some measure be gathered from this concise account of his life; and as a citizen of the world his piety was unaffected, his morals pure, his integrity undeviating, his spirit generous and disinterested, and his whole manners highly amiable. The only publication of our author's, besides those already mentioned, consisted of "Memoirs illustrative of the History of Astronomy," in two volumes 4to.

Lisle, *Sir John*, a brave loyalist in the time of the civil wars, was the son of a bookseller in London, and received his education in the Netherlands. He signalized himself upon many occasions in the civil war, particularly in the last battle of Newbury; where, in the dusk of the evening, he led his men to the charge in his shirt, that his person might be more conspicuous. The king, who was an eye-witness of his bravery, knighted him on the field of battle. In 1648, he rose for his majesty in Essex; and was one of the royalists who

who so obstinately defended Colchester, and who died for the defence of it. This brave man having tenderly embraced the corpse of Sir Charles Lucas, his departed friend, immediately presented himself to the soldiers who stood ready for his execution. Thinking that they stood at too great a distance, he desired them to come nearer: one of them said, "I warrant you, Sir, we shall hit you." He replied with a smile, "Friends, I have been nearer you when you have missed me." He was executed August 28. 1648.

LISMORE, one of the Western islands of Scotland, seated at the mouth of Loch Linnhe, an arm of the sea in Argyleshire, navigable for the largest ships to Fort William, which is in the country called Lochaber. This island is 10 miles in length by one in breadth; and contains above 1000 inhabitants. It abounds in limestone, which forms a fine loamy and very fertile soil, yielding rich crops of barley. This island was formerly the residence of the bishop of Argyle, from which he was frequently named *Episcopus Lismorensis*. Great part of the cathedral yet remains, and part of it is still employed as the parish church. The bishop's castle stands four miles from the cathedral; the walls are yet pretty entire. There are some vestiges of fortified camps, and an old castle with a ditch and drawbridge, which, it is said, were erected by the Danes.

Lismore, a borough town of Ireland, in the county of Waterford, and province of Munster, 100 miles from Dublin; N. Lat. 52. 5. W. Long. 7. 50. It was anciently called *Lessmore* or *Lios-more*, i. e. the great enclosure, or habitation; it is now a bishopric, and formerly had an university. St Carthagh or Mochuda, in the beginning of the seventh century, founded an abbey and school in this place, which in a short time was much resorted to, not only by the natives, but also by the Britons and Saxons, during the middle ages. According to an ancient writer of the life of St Carthagh, Lismore was in general inhabited by monks, half of it being an asylum into which no woman dared enter; consisting entirely of cells and monasteries, the ruins of which, with seven churches, are yet visible. A castle was built here by King John. The site of Lismore was in early ages denominated *magh skia*, or the "chosen shield," being the situation of a dun or fort of the ancient chieftans of the Decies, one of whom granted it to St Carthagh on his expulsion from the abbey of Ratheny in Westmeath. On becoming an university, Math Sgiath obtained the name of *Dunsginne*, or the "fort of the Saxons," from the number of Saxons who resorted thereto: but soon after, it was called *Lios-more* or *Less-more*, and now *Lismore;* the bishopric of which was united to that of Waterford in 1363, being 730 years after its foundation. The public road to Cork was formerly through this place, and at that time it had a better face of business. St Carthagh, who retired to this place with some of his religious in 636, to avoid the fury of the then Irish monarch, tied his disciples to a most strict rule of life; they never were allowed the use of flesh, fish, or fowl; only the vegetables that the ground produced at the expence of their own labour. Father Daniel, in his *Histoire Monastique*, mentions one on the same foundation in France. The castle here, which, as we have formerly mentioned, was built by King John, was erected in 1195 on the ruins of the abbey of St Carthagh: it belonged to the duke of Devonshire, and gave birth to the great philosopher Robert Boyle. In 1189 it was demolished by the Irish, who took it by surprise. Being afterwards reedified, it was for many years an episcopal residence, till Myler Magrath, archbishop of Cashel, and bishop of this see, granted the manor of Lismore to that noted scholar and soldier Sir Walter Raleigh, in the reign of Queen Elizabeth, at the yearly rent of 13l. 6s. 8d.; but that estate was lopped off with his head in the reign of King James I. After which it fell into the hands of Sir Richard Boyle, who purchased all Sir Walter's lands; he beautified the whole, and added many buildings to it, most of which were burned down in the Irish rebellion; at the breaking out of which, it was closely besieged by 5000 Irish commanded by Sir Richard Beling, and was well defended by the young Lord Broghill, third son of the earl of Cork, who obliged them to raise the siege. The castle is boldly seated on the verge of a rocky hill, rising almost perpendicularly to a considerable height over the river Blackwater. The entrance is by an ancient and venerable avenue of trees. Over the gate are the venerable arms of the first earl of Cork. Opposite to the entrance is a modern portico of Bath stone, of the Doric order, designed by Inigo Jones. Most of the buildings have remained in ruins since the era of the rebellion; but the several offices that make up two sides of the square are kept in repair. At each angle is a tower, the chief remains of its former magnificence. In October 1785, the late duke of Rutland, then lord lieutenant of Ireland, whilst on a tour in Munster, held a council in, and issued proclamations from this castle. The cathedral is still pretty well kept in repair. Here is a fine bridge over the river Blackwater, erected at a very great expence by the duke of Devonshire: this bridge is remarkable for the extent of the principal arch, the span of it being 102 feet. Below the town is a rich fishery for salmon, which is the greatest branch of trade here. Though this place is at present much reduced, yet Cambrensis informs us, that, not many years after the conquest, this was a very rich city, and held out some time against the English, who took it at last by storm, and gained rich plunder here, enough to load 16 sail of ships.

LISSA, an island in the gulf of Venice, on the coast of Dalmatia, belonging to the Venetians, where they have a fishery of sardines and anchovies. It produces excellent wine, and is 70 miles west of Ragusa. E. Long. 17. 0. N. Lat. 43. 22.

Lissa, a town of Poland, in the palatinate of Posna, of which it is the capital. E. Long. 16. 0. N. Lat. 32. 15.

Lissa, a village of Silesia, 16 miles from Breslau, remarkable for a battle fought between the Prussians and the Austrians on the 15th of December 1757, when the latter were entirely defeated.

LISSUS, in *Ancient Geography*, the last town of Illyricum, towards Macedonia, situated on the Drilo. It had a capacious port, the work of Dionysius the Tyrant, who led the colony thither, enlarged and walled it round, (Diodorus Siculus.) Now called *Alessio*, in Albania, on the Drino, near the gulf of Venice. E. Long. 20. N. Lat. 42.

LIST, in commerce, the border of cloth or stuff; serving

List. serving not only to show their quality, but to preserve them from being torn in the operations of fulling, dying, &c.—List is used on various occasions; but chiefly by gardeners for securing their wall-trees.

List, in *Architecture*, a little square moulding, otherwise called a *fillet*, *listel*, &c. See Architecture.

List, is also used, to signify the enclosed field or ground wherein the ancient knights held their justs and combats. It was so called, as being hemmed round with pales, barriers, or stakes, as with a list. Some of these were double, one for each cavalier; which kept them apart, so that they could not come nearer each other than a spear's length. See Just, Tournament, Duel, &c.

Civil List, in the British polity. The expences defrayed by the civil list are those that in any shape relate to civil government; as, the expences of the household; all salaries to officers of state, to the judges, and every one of the king's servants, the appointments to foreign ambassadors; the maintenance of the queen and royal family; the king's private expences, or privy-purse; and other very numerous outgoings, as secret-service money, pensions, and other bounties: which sometimes have so far exceeded the revenues appointed for that purpose, that application has been made to parliament to discharge the debts contracted on the civil list; as particularly in 1724, when one million was granted for that purpose by the statute 11 Geo. I. c. 17. and, in 1769, when half a million was appropriated to the like uses by the statute 9 Geo. III. c. 34.

Blackst. Comment. The civil list is indeed properly the whole of the king's revenue in his own distinct capacity; the rest being rather the revenue of the public, or its creditors, though collected and distributed again in the name and by the officers of the crown: it now standing in the same place, as the hereditary income did formerly; and as that has gradually diminished, the parliamentary appointments have increased. The whole revenue of Queen Elizabeth did not amount to more than 600,000l. a-year: that of King Charles I. was 800,000l. and the revenue voted for King Charles II. was 1,200,000l. though complaints were made (in the first years at least) that it did not amount to so much. But it must be observed, that under these sums were included all manner of public expences; among which Lord Clarendon, in his speech to the parliament, computed that the charge of the navy and land forces amounted annually to 800,000l. which was ten times more than before the former troubles. The same revenue, subject to the same charges, was settled on King James II.: but by the increase of trade, and more frugal management, it amounted on an average to 1,500,000l. per annum, (besides other additional customs granted by parliament, which produced an annual revenue of 400,000l.), out of which his fleet and army were maintained at the yearly expence of 1,100,000l. After the Revolution, when the parliament took into its own hands the annual support of the forces both maritime and military, a civil list revenue was settled on the new king and queen, amounting, with the hereditary duties, to 700,000l. per annum; and the same was continued to Queen Anne and King George I. That of King George II. was nominally augmented to 800,000l*, and in fact was considerably more: but that of his present majesty is expressly limited to that sum; though 100,000l. hath been since added. And upon the whole, it is doubtless much better for the crown, and also for the people, to have the revenue settled upon the modern footing rather than the ancient. For the crown, because it is more certain, and collected with greater ease; for the people, because they are now delivered from the feudal hardships, and other odious branches of the prerogative. And though complaints have sometimes been made of the increase of the civil list, yet if we consider the sums that have been formerly granted, the limited extent under which it is now established, the revenues and prerogatives given up in lieu of it by the crown, the numerous branches of the present royal family, and (above all) the diminution of the value of money compared with what it was worth in the last century, we must acknowledge these complaints to be void of any rational foundation; and that it is impossible to support that dignity, which a king of Great Britain should maintain, with an income in any degree less than what is now established by parliament. See Revenue.

* See *Revenue*.

To List or Enlist Soldiers, to retain and enroll men as soldiers, either as volunteers, or by a kind of compulsion. Persons listed must be carried within four days, but not sooner than 24 hours after, before the next justice of peace of any county, riding, city, or place, or chief magistrate of any city or town corporate (not being an officer in the army); and if before such justice or magistrate they dissent from such enlisting, and return the enlisting money, and also 20 shillings in lieu of all charges expended on them, they are to be discharged. But persons refusing or neglecting to return and pay such money within 24 hours, shall be deemed as duly listed as if they had assented thereto before the proper magistrate; and they shall, in that case, be obliged to take the oath, or, upon refusal, they shall be confined by the officer who listed them till they do take it.

LISTER, Dr Martin, an eminent English physician and naturalist, was born in 1638, and educated at Cambridge. He afterwards travelled into France; and at his return practised physic at York, and afterwards at London. In 1683 he was created doctor of physic, and became fellow of the College of Physicians in London. In 1698, he attended the earl of Portland in his embassy from King William III. to the court of France; of which journey he published an account at his return, and was afterwards physician to Queen Anne. He also published, 1. *Historia animalium Angliæ*, quarto. 2. *Conchyliorum synopsis*, folio. 3. *Cochlearum et limachum exercitatio anatomica*, 4 vols. 8vo. 4. Many pieces in the Philosophical Transactions; and other works.

LISTOWEL, a parish, also a post and fair town, of Ireland, in the county of Kerry and province of Munster, 131 miles from Dublin, anciently *Lis Tuathal*, i. e. "the fort of Tuathal," who was exiled in the 1st century, but returned; and his life forms a brilliant era in Irish history. Near this are the ruins of a castle, pleasantly situated on the river Feale: it was taken in November 1600, by Sir Charles Wilmot, being then held out for Lord Kerry against Queen Elizabeth. Five miles beyond Listowel are the ruins of a church. The fairs are three in the year.

List || Litana Silva.

LITANA Silva, in *Ancient Geography*, a wood of

Litany, Litchfield.

of the Boii, in Gallia Togata, or Ciſpadana, where the Romans, under L. Poſthumius Albinus (whoſe head the Boii cut off, and carried in triumph into their moſt ſacred temple), had a great defeat; of twenty-five thouſand ſcarcely ten eſcaping (Livy). Holſtenius conjectures, that this happened above the ſprings of the Scultenna, in a part of the Appennine, between Cerſinianum and Mutina. Now Selva di Lugo.

LITANY, a ſolemn form of ſupplication to God, in which the prieſt utters ſome things fit to be prayed for, and the people join in their interceſſion, ſaying, *we beſeech thee to hear us, good Lord*, &c. The word comes from the Greek λιτανεια, "ſupplication;" of λιτανευω, "I beſeech."

At firſt the uſe of litanies was not fixed to any ſtated time, but were only employed as exigencies required. They were obſerved, in imitation of the Ninevites, with ardent ſupplications and faſtings, to avert the threatening judgements of fire, earthquakes, inundations, or hoſtile invaſions. About the year 400, litanies began to be uſed in proceſſions, the people walking barefoot, and repeating them with great devotion; and it is pretended, that by this means ſeveral countries were delivered from great calamities. The days on which theſe were uſed were called *rogation days*: theſe were appointed by the canons of different councils, till it was decreed by the council of Toledo, that they ſhould be uſed every month throughout the year; and thus by degrees they came to be uſed weekly on Wedneſdays and Fridays, the ancient ſtationary days for faſting. To theſe days the rubric of our church has added Sundays, as being the greateſt days for aſſembling at divine ſervice. Before the laſt review of the common prayer, the litany was a diſtinct ſervice by itſelf, and uſed ſome time after the morning prayer was over; at preſent it is made one office with the morning ſervice, being ordered to be read after the third collect for grace, inſtead of the interceſſional prayers in the daily ſervice.

LITCHFIELD, a city of Staffordſhire, in England, 117 miles from London. It ſtands low, about three miles from the Trent: and its ancient name is ſaid to have been *Licidfield*, ſignifying, "a field of carcaſſes," from a great number of Chriſtians having, as it is pretended, ſuffered martyrdom here in the perſecution under Diocleſian. In the Saxons time, it was a biſhoprick for a ſhort ſpace; and is now, together with Coventry, a biſhoprick. It is divided into two parts by a rivulet and a kind of ſhallow lake, over which are two cauſeways with ſluices. It is a long ſtraggling place; but has ſome very handſome houſes, and well paved clean ſtreets. That part on the ſouth ſide of the rivulet is called the *city*, and the other the *cloſe*. The *city* is much the largeſt, and contains ſeveral public ſtructures. It was incorporated by Edw. VI. with the name of bailiffs and burgeſſes; and is both a town and county, governed by 2 bailiffs choſen yearly out of 24 burgeſſes, a recorder, a ſheriff, a ſteward, and other officers. The city has power of life and death within their juriſdiction, a court of record, and a piepowder court. Here is a gaol both for debtors and felons, a free ſchool, and a pretty large well endowed hoſpital, for a maſter and 12 brethren. The county of the city is 10 or 12 miles in compaſs, which the ſheriff rides yearly on the 8th of September, and then feaſts the corporation and neighbouring gentry. The *cloſe* is ſo called from its being encloſed with a wall and a deep dry ditch on all ſides except towards the city, where it is defended by a great lake or marſh formed by its brook. The cathedral, which ſtands in the cloſe, was originally built by Oſwius king of Northumberland about 300. It was rebuilt and enlarged by Offa king of Mercia in 766. In 1148 was rebuilt, and greatly enlarged in 1296. At the reformation, Coventry was divided from it. In the civil wars its ſpire was deſtroyed, and it converted to a ſtable. In 1776 a beautiful painted window, by the benefaction of Dr Adenbrook, has been ſet up at the weſtern end of the cathedral. In the civil wars it was ſeveral times taken and retaken, and thereby ſuffered much; but was ſo repaired after the reſtoration, at the expence of 20,000l. that it was one of the faireſt and nobleſt ſtructures of the kind in England. It is walled in like a caſtle, and ſtands ſo high as to be ſeen 10 miles round. It is 450 feet long, of which the choir is 110, and the breadth in the broadeſt place 80. Its portico is hardly to be paralleled in England. There were, till lately, 26 ſtatues of the prophets, apoſtles, kings of Judah, and ſome kings of this land, in a row above it, as big as the life; and on the top, at each corner of the portico, is a ſtately ſpire, beſides a fine high ſteeple on the middle of the church. The choir is paved in great part with alabaſter and cannel coal, in imitation of black and white marble. In 1789 it underwent a general repair, when the maſſive groined arch betwixt the weſt end of the church and the tranſept, which had forced the ſide wall out of its perpendicular, was removed. The prebendaries ſtalls, which are thought to be the beſt in England, were moſt of them re-erected at the charge of the country gentlemen, whoſe names and arms are painted at the top of the ſtalls. The north door is extremely rich in ſculpture, but much injured by time. The body which is ſupported by pillars formed of numbers of ſlender columns, has lately had its decayed leaden roof replaced by a neat ſlated covering. The choir merits attention on account of the elegant ſculpture about the windows, and the embattled gallery that runs beneath them; to which the altarpiece of Grecian architecture but ill correſponds; behind which is Mary's chapel, divided from it by a moſt elegant ſtone ſkreen of beautiful workmanſhip. Here ſtood St Chad's ſhrine, which coſt 2000l. The charter houſe is an octagon room. In the ſame cloſe are the palaces of the biſhop and dean, and the prebendaries houſes in a court on the hill. Here are three other churches; one of which, St Michael's, has a churchyard of 6 or 7 acres. There was a caſtle here, long ſince deſtroyed: and ancient camps have been diſcovered in its environs. In the neighbourhood are frequent horſe races. The markets there are on Tueſday and Friday, and ſix fairs in the year. By the late inland navigation, this place has communication with the rivers Merſey, Dee, Ribble, Ouſe, Trent, Darwent, Severn, Humber, Thames, Avon, &c. which navigation, including its windings, extends above 500 miles in the counties of Lincoln, Nottingham, York, Lancaſter, Weſtmoreland, Cheſter, Warwick, Litchfield.

wick, Leicester, Oxford, Worcester, &c. Litchfield sends two members to parliament.

LITERARY, any thing belonging to LITERATURE.

Literary Property, or *Copy Right*. See *Copy Right*.

LITERATI (*letrados*, "lettered"), an epithet given to such persons among the Chinese as are able to read and write their language. The literati alone are capable of being made mandarins.

LITERATI, is also the name of a particular sect, either in religion, philosophy, or politics, consisting principally of the learned men of that country; among whom it is called *jukiao*, i. e. "learned."

It had its rise in the year of Christ 1400, when the emperor, to awaken the native affection of the people for knowledge, which had been quite banished by the preceding civil wars among them, and to stir up emulation among the mandarins, chose out 42 of the ablest among their doctors, to whom he gave a commission to compose a body of doctrine agreeable to that of the ancients, which was then become the rule or standard of the learned. The delegates applied themselves to the business with very great attention: but some fancied them rather to have wrested the doctrine of the ancients, to make it consist with theirs, than to have built up theirs on the model of the ancients.

They speak of the Deity, as if it were no more than mere nature or the natural power or virtue that produces, disposes, and preserves, the several parts of the universe. It is, say they, a pure, perfect principle, without beginning or end; it is the source of all things, the essence of every being, and that which determines it to be what it is. They make God the soul of the world: they say, he is diffused through all matter, and produces all the changes that happen there. In short, it is not easy to determine, whether they resolve God into nature, or lift up nature into God; for they ascribe to it many of those things which we attribute to God.

This doctrine, in lieu of the idolatry that prevailed before, introduced a refined kind of atheism. The work, being composed by so many persons of learning and parts, and approved by the emperor himself, was received with infinite applause by all the people. Many were pleased with it, because it seemed to subvert all religion; others approved it, because the little religion that it left them could not give them much trouble. And thus was formed the sect of the Literati: which consists of the maintainers and adherents to this doctrine.

The court, the mandarins, and the persons of fortune and quality, &c. are generally retainers to it; but a great part of the common people still hold to their worship of idols.

The literati freely tolerate the Mahometans, because they adore, with them, the King of heaven, and Author of nature; but they bear a perfect aversion to all sorts of idolaters among them: and it was once resolved to extirpate them. But the disorder this would have occasioned in the empire prevented it; they now content themselves with condemning them, in general, as heresies; which they do solemnly every year at Pekin.

LITERATURE denotes learning or skill in letters.

LITERNUM. See LINTERNUM.

LITHANTHRAX, or *Pit-Coal*, is a black or brown, laminated, bituminous substance; not very easily inflammable, but, when once inflamed, burns longer and more intensely than any other substance. See MINERALOGY *Index*.

LITHARGE, a preparation of lead, usually in form of soft flakes, of a yellowish reddish colour. If calcined lead be urged with a hasty fire, it melts into the appearance of oil, and on cooling concretes into litharge. Greatest part of the litharge met with in the shops is produced in the purification of silver from lead, and the refining of gold and silver by means of this metal: according to the degree of fire and other circumstances, it proves of a pale or deep colour: the first has been commonly called *litharge of silver*, the other *litharge of gold*. See LEAD, CHEMISTRY *Index*.

LITHGOW, WILLIAM, a Scotsman, whose sufferings by imprisonment and torture at Malaga, and whose travels, on foot, over Europe, Asia, and Africa, seem to raise him almost to the rank of a martyr and a hero, published an account of his peregrinations and adventures. Though the author deals much in the marvellous, the horrid account of the strange cruelties of which, he tells us, he was the subject, have, however, an air of truth. Soon after his arrival in England from Malaga, he was carried to Theobald's on a feather-bed, that King James might be an eyewitness of his *martyred anatomy*, by which he means his wretched body, mangled and reduced to a skeleton. The whole court crowded to see him; and his majesty ordered him to be taken care of, and he was twice sent to Bath at his expence. By the king's command he applied to Gondamor, the Spanish ambassador, for the recovery of the money and other things of value which the governor of Malaga had taken from him, and for 1000l. for his support. He was promised a full reparation for the damage he had sustained: but the perfidious minister never performed his promise. When he was upon the point of leaving England, Lithgow upbraided him with the breach of his word in the presence-chamber, before several gentlemen of the court. This occasioned their fighting upon the spot; and the ambassador, as the traveller oddly expresses it, had his fistula (with which disorder he was afflicted) contrabanded with his fist. The unfortunate Lithgow, who was generally condemned for his spirited behaviour, was sent to the Marshalsea, where he continued a prisoner nine months. At the conclusion of the octavo edition of his *Travels* he informs us, that, in his three voyages, "his painful feet have traced over (besides passages of seas and rivers) 36,000 and odd miles, which draweth near to twice the circumference of the whole earth." Here the marvellous seems to rise to the incredible; and to set him, in point of veracity, below Coryat, whom it is nevertheless certain that he far outwalked. His description of Ireland is whimsical and curious. This, together with the narrative of his sufferings, is reprinted in Morgan's *Phœnix Britannicus*.

LITHIASIS, or STONE. See MEDICINE *Index*.

LITHOMANTIA, in antiquity, a species of divination performed with stones. Sometimes the stone called *siderites* was used: this they washed in spring-water in the night by candle-light; the person that consulted

consulted it was to be purified from all manner of pollution, and to have his face covered: this done, he repeated divine prayers, and placed certain characters in an appointed order; and then the stone moved of itself, and in a soft gentle murmur, or (as some say) in a voice like that of a child, returned an answer. By a stone of this nature, Helenus is reported to have foretold the destruction of Troy.

LITHONTRIPTICS (from λιθος "a stone," and θρυπτω "to break"); an epithet for medicines that are supposed to break the stone in the bladder. Though the different stones that are generated in the human bladder require different solvents when out of the body; and though art hath not yet afforded a medicine which, when injected into the bladder, will, without injury thereto, dissolve the stone therein lodged; it cannot thence be concluded, that there are no lithontriptic medicines. It may be here observed, that one solvent affects one subject, but hath no effect on another; so a solvent may yet be met with that will destroy the stone, and not hurt the human body. The water into which the boiled white of egg dissolves will liquefy myrrh, but may be put into the human eye without causing any uneasiness.

Soap ley taken at first in small doses in broth that is freed from all its fat, succeeds in most cases which require an alkaline solvent. The patient may begin with 20 drops, and gradually increase the dose as he is able; and by repeating it three times a-day for six, eight, or twelve months, the wished-for effects often follow.

LITHOPHYTA, the name of Linnæus's third order of vermes. See HELMINTHOLOGY *Index*.

LITHOSPERMUM, GROMWELL, a genus of plants belonging to the pentandria class; and in the natural method ranking under the 41st order, *Asperifoliæ*. See BOTANY *Index*.

LITHOSTROTON, among the Romans, was a pavement of mosaic work, consisting of small pieces of cut marble of different kinds and colours, first used in the time of Sylla, who made one at Præneste in the temple of Fortune, and afterwards in private houses; and were brought to such perfection, that they exhibited most lively representations of nature, with all the accuracy of the finest painting.

LITHOTOMY, in *Surgery*, the operation of cutting for the stone. See SURGERY *Index*.

LITHUANIA, an extensive province of Poland. By the natives it is called *Letwa*, and has Great Poland and Russia on the west; part of Muscovy on the east; Livonia, the Baltic sea, and part of Muscovy, on the north; Red Russia, Volhinia, and Podolia, on the south; and the Ukraine on the south-east. Its length is said to be about 360, and its breadth 340 miles; but it is much indented both ways. Lithuania was anciently overrun with wood; and there are still many forests in it, which yield a great deal of honey, wax, pitch, tar, and timber; and abound with wild boars, buffaloes, elks, wild horses, wild asses, uri, and woodcocks. The lakes are also numerous, and well stored with fish: but the air, by reason of these forests and lakes, is said to be thick and foggy. The country produces a great deal of buck wheat and other corn; the pastures are luxuriant, and the flocks and herds numerous: so that, notwithstanding agriculture is much neglected, but provisions are exceeding cheap, and money so scarce, that 10 per cent. is the common interest. The principal nobility have large estates, and live in great pomp and splendour, generally retaining some hundreds of those that are poor, in quality of domestics. The established religion is Popery; but Lutherans, Calvinists, Jews, Turks, Greeks, and Socinians, are very numerous. Lithuania was governed by its own dukes till it was united to Poland, towards the end of the 14th century, when the great duke Jagello married Hedwig, the dowager of Louis king of Poland and Hungary. It had even dukes after that, but they were subordinate to the king; and at this day, though one diet serves for both countries, yet each has its peculiar laws, customs, dialect, and privileges. In a diet held at Lublin in 1569, it was more closely united to Poland than it had been before; and it was enacted, that both countries, for the future, should form but one state under the same prince. As to their courts of justice, the tenth part of what is adjudged in all real actions goes always to the judge's box, and is immediately paid in court; and in personal actions he claims half the damages given. A nobleman is only fined for murder, as in Poland. The dialect is a language of the Sclavonic; and they speak here, as in Poland, a barbarous kind of Latin. Lithuania is divided into nine palatinates. Another division is into Lithuania properly so called, and Lithuanian Russia. Some also comprehend under it Samogitia and Courland, which is a fief of Poland.

LITMUS, or LACMUS, in the arts, is a blue pigment, formed from *archil*. It is brought from Holland at a cheap rate; but may be prepared by adding quicklime and putrified urine, or spirit of urine distilled from lime, to the archil previously bruised by grinding. The mixture having cooled, and the fluid suffered to evaporate, becomes a mass of the consistence of a paste, which is laid on boards to dry in square lumps. It is only used in miniature paintings, and cannot be well depended on, because the least approach of acid changes it instantly from blue to red. The best litmus is very apt to change and fly.

LITTER *(lectica)*, a kind of vehicle borne upon shafts; anciently esteemed the most easy and genteel way of carriage. Du Cange derives the word from the barbarous Latin *lecteria* "straw or bedding for beasts." Others will rather have it come from *lectus* "bed;" there being ordinarily a quilt and a pillow to a litter in the same manner as to a bed.

Pliny calls the litter the *traveller's chamber;* it was much in use among the Romans, among whom it was borne by slaves kept for that purpose; as it still continues to be in the east, where it is called a *palanquin*—The Roman lectica, made to be borne by four men, was called *tetraphorum;* that borne by six *hexaphorum;* and that borne by eight *octaphorum.*

The invention of litters, according to Cicero, was owing to the kings of Bithynia: in the time of Tiberius they were become very frequent at Rome, as appears from Seneca; and even slaves themselves were borne in them, though never by more than two persons, whereas men of quality had six or eight.

LITTER also denotes a parcel of dry old straw put on the floor of a horse's stall for him to lie down and rest upon. When a horse comes tired into a stable, fresh litter

litter has the virtue of making him ſtale immediately. This is known to be a very great advantage to a horſe in a tired ſtate; and when the litter is old and dirty, it never has any ſuch effect upon him. If the owners knew how refreſhing it is for a horſe to diſcharge his urine on his return from labour, they would be more careful of giving them all means and occaſions of it than they are. This ſtaling after fatigue prevents thoſe obſtructions in the neck of the bladder or urinary paſſages which horſes are too ſubject to.

LITTLETON, Sir Thomas, judge of the common pleas, was the eldeſt ſon of Thomas Weſtcote, Eſq. of the county of Devon, by Elizabeth, ſole heireſs of Thomas Littleton of Frankley in Worceſterſhire, at whoſe requeſt he took the name and arms of that family. He was educated at one of our univerſities, probably at Cambridge. Thence he removed to the Inner Temple, where he became one of the readers; and was afterwards, by Henry VI. made ſteward or judge of the court of the palace, or marſhalſea of the king's houſehold. In 1455, the thirty-third of that reign, he was appointed king's ſerjeant, and rode the northern circuit as judge of aſſize. In 1462, the ſecond of Edward IV, he obtained a pardon from the crown; and, in 1466, was appointed one of the judges of the common pleas, and rode the Northamptonſhire circuit. In the year 1474 he was, with many of the firſt nobility, created knight of the Bath. He died in 1481; and was buried in the cathedral church of Worceſter, where a marble tomb, with his ſtatue upon it, was erected to his memory. As to his character as a lawyer, it is ſufficient to inform the reader, that he was the author of the Treatiſe upon Tenures, on which Sir Edward Coke wrote a comment, well known by the title of *Coke upon Littleton*.

Littleton, *Adam*, deſcended from an ancient family in Shropſhire, was born in 1627, educated at Weſtminſter ſchool, and went to Oxford a ſtudent of Chriſt-church, whence he was ejected by the parliament viſitors in 1648. Soon after, he became uſher of Weſtminſter ſchool, and in 1658 was made ſecond maſter of Weſtminſter ſchool. After the reſtoration he taught a ſchool at Chelſea in Middleſex, of which church he was admitted rector in the year 1664. In 1670 he accumulated the degrees in divinity, being then chaplain in ordinary to his majeſty. In 1674, he became prebendary of Weſtminſter, of which church he was afterwards ſub-dean. Beſide the well-known *Latin* and *Engliſh* Dictionary, he publiſhed ſeveral other works. He died in 1694, and was interred at Chelſea. He was an univerſal ſcholar; and extremely charitable, humane, and eaſy of acceſs.

LITURGY, denotes all the ceremonies in general belonging to divine ſervice.

The word comes from the Greek λειτεργια "ſervice, public miniſtry;" formed of λειτος "public," and εργον "work."

In a more reſtrained ſignification, liturgy is uſed among the Romaniſts to ſignify the *maſs*; and among us the *common prayer*.

All who have written on liturgies agree, that in the primitive days divine ſervice was exceedingly ſimple, only clogged with a very few ceremonies, and conſiſting of but a ſmall number of prayers; but, by degrees,

they increaſed the number of external ceremonies, and added new prayers, to make the office look more awful and venerable to the people. At length things were carried to ſuch a pitch, that a regulation became neceſſary; and it was found proper to put the ſervice, and the manner of performing it, into writing; and this was what they called a *liturgy*.

Liturgies have been different at different times, and in different countries. We have the liturgy of St Chryſoſtom, that of St Peter, of St James, the liturgy of St Baſil, the Armenian liturgy, the liturgy of the Maronites, of the Cophtæ, the Roman liturgy, the Gallican liturgy, the Engliſh liturgy, the Ambroſian liturgy, the Spaniſh and African liturgies, &c.

In the more early ages of the church, every biſhop had a power to form a liturgy for his own dioceſe; and if he kept to the analogy of faith and doctrine, all circumſtances were left to his own diſcretion. Afterwards the practice was for the whole province to follow the metropolitan church, which alſo became the general rule of the church: and this Lindwood acknowledges to be the common law of the church; intimating, that the uſe of ſeveral ſervices in the ſame province, which was the caſe in England, was not to be warranted but by long cuſtom. The liturgy of the church of England was compoſed in the year 1547, and eſtabliſhed in the ſecond year of King Edward VI. ſtat. 2. and 3. Ed. VI. cap. 1.

In the fifth year of this king it was reviewed; becauſe ſome things were contained in that liturgy which ſhowed a compliance with the ſuperſtition of thoſe times, and ſome exceptions were taken againſt it by ſome learned men at home, and by Calvin abroad. Some alterations were made in it, which conſiſted in adding the general confeſſion and abſolution, and the communion to begin with the ten commandments. The uſe of oil in confirmation and extreme unction was left out, and alſo prayers for ſouls departed, and what tended to a belief of Chriſt's real preſence in the euchariſt. This liturgy, ſo reformed, was eſtabliſhed by the act of 5 and 6 Ed. VI. cap. 1. However, it was aboliſhed by Queen Mary, who enacted, that the ſervice ſhould ſtand as it was moſt commonly uſed in the laſt year of the reign of King Henry VIII. The liturgy of 5 and 6 Ed. VI. was re-eſtabliſhed with ſome few alterations and additions, by 1 Eliz. cap. 2. Some farther alterations were introduced, in conſequence of the review of the common-prayer book, by order of King James, in the firſt year of his reign; particularly in the office of private baptiſm, in ſeveral rubricks and other paſſages, with the addition of five or ſix new prayers and thankſgivings, and all that part of the catechiſm which contains the doctrine of the ſacraments. The book of common-prayer, ſo altered, remained in force from the firſt year of King James to the fourteenth of Charles II. But the laſt review of the liturgy was in the year 1661, and the laſt act of uniformity enjoining the obſervance of it is 13 and 14 Car. II. cap. 4. See Common-Prayer. Many applications have been ſince made for a review, but hitherto without ſucceſs.

LITUUS, among the Romans, was the ſtaff made uſe of by the augurs in quartering the heavens. It bore a great reſemblance to the croſier of a biſhop, but was ſhorter. It was crooked at one end, and thickeſt

in

in the curved part, according to A. Gellius. We frequently meet with a reprefentation of it upon medals, amongft other pontifical inftruments. It was called *Lituus Quirinalis*, from Quirinus, a name of Romulus, who was fkilled in all the myfteries of augury.

Lituus, was alfo an inftrument of mufic in ufe in the Roman army. It was ftraight, excepting that it had a little bending at the upper end like a lituus or facred ftaff of the augurs; and from the fimilitude it derived its name.

LIVADIA, anciently *Achaia* and *Hellas*, or *Greece* properly fo called; a province of Turkey in Europe, bounded on the north by Epirus and Theffaly, from which it is feparated by Mount Oëta, now Banina, and by the Euripus, now the ftrait of Negropont; on the eaft, by the Archipelago; on the fouth, by the gulf of Engia or Egina, the ifthmus of Corinth, and the gulf of Lepanto; and on the weft, by the Ionian fea and part of Epirus. Its extent is about 130 miles from north-weft to fouth-eaft; but its greateft breadth is not above 36 miles. It is in general a mountainous country; but neither unpleafant nor unfruitful. The principal mountains are, Mount Oëta in Bœotia, where is the famous pafs of Thermopylæ, not above 25 feet broad; and Parnaffus, Helicon, and Cythæron in Phocis, which were facred to Apollo and the mufes, and confequently much celebrated by the poets. The rivers of moft note are, the Sionapro, anciently the Achelous, the Cephiffus, the Ifmenus, and the Afopus. The province is at prefent divided into Livadia proper, Stramulippa, and the duchy of Athens. The principal places are, Lepanto, anciently Naupactus; Livadia, anciently Libadia or Lebadia; the celebrated city of Athens, now Setines; Thebes, now Stibes; Lepfina, anciently Eleufis; Caftri, formerly Delphi; and Megara.

Livadia, an ancient town of Turkey in Europe, and capital of a province of the fame name in Greece. It is a large and populous place, feated on the gulf of Lepanto, about 25 miles from the city of that name. It has now a confiderable trade in woollen ftuffs and rice. Anciently it was celebrated for the oracle of Trophonius, which was in a cavern in a hill above the town. E. Long. 23. 29. N. Lat. 38. 40.

LIVER, fee Anatomy, N° 96.—Plato, and others of the ancients, fix the principle of love in the liver; whence the Latin proverb, *Cogit amare jecur*: and in this fenfe Horace frequently ufes the word, as when he fays, *Si torrere jecur quærus Idoneum.* The Greeks, from its concave figure, called it ἧπαρ, "vaulted, fufpended;" the Latins call it *jecur*, q. d. *juxta cor*, as being "near the heart." The French call it *foye*, from *foyer*, *focus*, or "fireplace;" agreeable to the doctrine of the ancients, who believed the blood to be boiled and prepared in it.—Erafiftratus, at firft, called it *parenchyma*, i. e. *effufion*, or *mafs of blood*; and Hippocrates, by way of eminence, frequently calls it the *hypochondrium*.

Liver of Antimony. See Chemistry *Index*.

Liver of Arfenic, is a combination of white arfenic with potafh. See Arsenic, Chemistry *Index*.

Liver of Sulphur. See *Potash, Sulphuret of*, Chemistry *Index*.

Liver-Wort. See Marchantia and Lichen, Botany *Index*

LIVERPOOL, a large, flourifhing, and populous town of England, in the county of Lancafter, fituated at the influx of the river Merfey into the fea. This town has fo much increafed in trade fince the commencement of the prefent century, that it is now the greateft fea-port in England except London, having exceeded Briftol confiderably of late years, which will appear by the following account of the cuftom-duties, received in the feveral ports of London, Liverpool, and Briftol, in the year 1784, taken from the report of the commiffioners for infpecting the ftate of public accounts.

London, -	L. 5,187,052	9	$5\frac{1}{2}$
Liverpool, -	640,684	2	$2\frac{1}{4}$
Briftol, - -	334,909	19	$3\frac{1}{2}$
Liverpool exceeded Briftol,	L.305,774	2	11

The following fhows how much the trade has increafed fince the above period:

Duties received in the port of Liverpool from July 5th 1785, to October 10th 1787, L.298,361 9 $10\frac{1}{2}$

The merchants here trade to all parts of the world except Turkey and the Eaft Indies; but the moft beneficial trade is to Guinea and the Weft Indies, by which many of them have acquired very large fortunes.

Liverpool, during the laft war, carried on more foreign trade than any town in England; and fuch is the ftate of it at this time, that there are near three thoufand veffels cleared from that port in one year to different parts of the world. Here are feveral manufactories for China-ware, and pot-houfes which make very fine ware, fome falt-works, glafs-houfes, and upwards of 50 breweries, from fome of which large quantities of malt liquor are fent abroad. Many of the buildings are formed in the moft elegant manner; but the old ftreets are narrow; which defect will foon be removed, as the corporation have lately obtained an act of parliament for the improvement of the town, which they have already begun to put in force with great fpirit, having taken down the principal ftreets in the centre of the town, and rebuilt them in a fpacious and moft magnificent manner; fo that in a few years it will be one of the handfomeft towns in England. This town contains fixteen churches, namely, St Peter's, St Nicholas's, St George's, St Thomas's, St Paul's, St Ann's, St John's, Trinity, St James's, St Catharine's, St Mary's, St Stephen's, St Matthew's, St Mark's, Chrift Church, and All Saints. There are alfo meetings for independents, anabaptifts, quakers, methodifts, and prefbyterians. The exchange is a noble ftructure, built of white ftone in the form of a fquare, and round it are piazzas where the merchants affemble to tranfact bufinefs. Above it are the mayor's offices, the feffions hall, the council-chamber, and two elegant ball-rooms. The expence of erecting this building amounted to 30,000l. The cuftom-houfe is fituated at the head of the old dock, and is a handfome and convenient ftructure. Here are many charitable foundations, among which is an excellent grammar fchool well endowed, and many of the youth taught in it have exhibitions in the univerfities. The infirmary is a large edifice of

Liverpool. brick and ſtone, ſituated on a hill in a very pleaſant airy ſituation, at one end of the town.

In the town is a charity-ſchool ſupported by voluntary ſubſcriptions and contributions for 50 boys and 12 girls, who are not only clothed and educated, but alſo provided with food and lodging: likewiſe ſeveral alms-houſes for the widows of ſeamen; and an excellent poor-houſe, ſuperior to any in the kingdom, where upwards of 800 men, women, and children, are ſupported, many of whom are employed in ſpinning cotton and wool. There are five large wet docks, three dry docks, and ſeveral graving docks for the repairing of ſhipping; which renders it the moſt commodious ſea-port in the world. The quays which bound theſe docks are covered with warehouſes; which is a convenience that enables the merchant to diſcharge his ſhip at a very ſmall expence. The new priſon lately finiſhed is a noble edifice, being built entirely on the plan of the great and benevolent Mr Howard, for ſolitary confinement; and is perhaps the moſt convenient, airy, magnificent building of the kind of Europe; being upon a very extenſive ſcale.

Liverpool received its charter from King John; but it was a borough by preſcription long before his reign. It is under the government of a recorder, mayor, and an unlimited number of aldermen, two bailiffs, and a common council of forty of the principal inhabitants, with a town-clerk and other proper officers. The town has a weekly market on Saturday, and is diſtant from London 204 miles. The progreſſive riſe of population in Liverpool, may be conceived by peruſing the following table:

Year.	Chriſtened.	Buried.	Married.
1660	3	—	—
1680	106	51	5
1700	132	124	35
1720	410	293	58
1740	485	608	137
1760	986	599	408
1780	1709	1544	606
1787	2267	1773	804

The whole population of Liverpool in the year 1793 was computed to amount to 56,782.

By means of inland navigation, Liverpool has communication with the rivers Dee, Ribble, Ouſe, Trent, Darwent, Severn, Humber, Thames, Avon, &c. which navigation, including its windings, extends above 500 miles, in the counties of Lincoln, Nottingham, York, Weſtmoreland, Cheſter, Stafford, Warwick, Leiceſter, Oxford, Worceſter, &c. The Merſey, upon which the town is ſituated, abounds with ſalmon, cod, flounders, turbot, plaice, and ſmelts; and at full ſea it is above two miles over. In the neighbourhood are frequent horſe-races, on a five-mile courſe, the fineſt for the length in England. The ſoil in and near the town is dry and ſandy, and particularly favourable to the growth of potatoes, on which the farmers often depend more than on wheat or any other grain. Freſh water is brought into the town by pipes, from ſome ſprings four miles off, purſuant to an act of parliament in the reign of Queen Anne. The dock duties of Liverpool in 1760 amounted to 2330l. but in 1805 to 33,364l. an aſtoniſhing proof of the rapid increaſe of its trade. The diſpenſary of this town does honour to human nature, and has been of the moſt ſingular advantage to the afflicted, ſince 172,273 perſons were cured of every diſorder incident to human nature, between the years 1778 and 1794, being on an average about 10,000 perſons every year. The Union News Room was inſtituted on the 1ſt of January 1801; the Lyceum much about the ſame period, the erection of which coſt the ſum of 11,000l. and the Commercial New's Room in 1803. The inſtitution for reſtoring drowned perſons is worthy of notice, as more than 400 people have become objects of it ſince it was founded, and more than one half of that number have been reſtored. The Athenæum, which compriſes a news room and library, was projected in 1798, and finiſhed before the cloſe of the year. There are four weekly papers publiſhed at Liverpool. From 1783 to 1793 incluſive the value of ſlaves imported into the Weſt Indies in Liverpool veſſels, amounted to 15,186,850l. ſterling; and the advantages which it derives from its inland navigation are more than can be properly eſtimated. Liverpool ſends two members to parliament.

Livery ‖ Livius.

LIVERY, in matters of dreſs and equipage, a certain colour and form of dreſs, by which noblemen and gentlemen chooſe to diſtinguiſh their ſervants.

Liveries are uſually taken from fancy, or continued in families by ſucceſſion. The ancient cavaliers, at their tournaments, diſtinguiſhed themſelves by wearing the liveries of their miſtreſſes: thus people of quality make their domeſtics wear their livery.

Father Meneſtrier, in his Treatiſe of Carouſals, has given a very ample account of the mixtures of colours in liveries. Dion tells us, that Oenomaus was the firſt who invented green and blue colours, for the troops which, in the circus, were to repreſent land and ſea fights.

The Romiſh church has alſo her ſeveral colours and liveries; white, for confeſſors and virgins, and in times of rejoicing; black, for the dead; red, for the apoſtles and martyrs; blue or violet, for penitents; and green, in times of hope.

Formerly, great men gave liveries to ſeveral, who were not of their family or ſervants, to engage them in their quarrels for that year; but this was prohibited by the ſtatutes 1 Rich. II. 1 Hen. IV. cap. 27. 2 and 7 Hen. IV. 8 Hen. VI. cap. 4. 8 Ed. IV. cap. 2; and no man, of whatever condition, was allowed to give any livery, but to his domeſtic officers, and counſel learned in the law. However, moſt of the above ſtatutes are repealed by 3 Car. I. cap. 4.

Livery of Seiſin, in *Law*, ſignifies delivering the poſſeſſion of lands, &c. to him who has a right to them.

LIVERYMEN of London, are a number of men choſen from among the freemen of each company. Out of this body the common-council, ſheriff, and other ſuperior officers for the government of the city, are elected; and they alone have the privilege of giving their votes for members of parliament, from which the reſt of the citizens are excluded.

LIVIUS, Titus, the beſt of the Roman hiſtorians, as he is called by Mr Bayle, was born at Patavium, or Padua. Few particulars of his life have been handed

Livius. handed down to us. Coming to Rome, he acquired the notice and favour of Auguſtus, and there he long reſided. Some have ſuppoſed, (for there is not any proof of it), that he was known to Auguſtus before, by certain Philoſophical Dialogues which he had dedicated to him. Seneca ſays nothing of the dedication: but mentions the dialogues, which he calls hiſtorical and philoſophical; and alſo ſome books, written purpoſely on the ſubject of philoſophy. Be this as it will, it is probable that he began his hiſtory as ſoon as he was ſettled at Rome; and he ſeems to have devoted himſelf ſo entirely to the great work he had undertaken, as to be perfectly regardleſs of his own advancement. The tumults and diſtractions of Rome frequently obliged him to retire to Naples; not only that he might be leſs interrupted in the purſuit of his deſtined taſk, but alſo enjoy that retirement and tranquillity which he could not have at Rome, and which yet he ſeems to have much ſought after: for he was greatly diſſatisfied with the manners of his age, and tells us, that "he ſhould reap this reward of his labour, in compoſing the Roman hiſtory, that it would take his attention from the preſent numerous evils, at leaſt while he was employed upon the firſt and earlieſt ages." He uſed to read parts of this hiſtory, while he was compoſing it, to Mecænas and Auguſtus; and the latter conceived ſo high an opinion of him, that he pitched upon him to ſuperintend the education of his grandſon Claudius, who was afterwards emperor. After the death of Auguſtus, Livy returned to the place of his birth, where he was received with all imaginable honour and reſpect: and there he died, in the fourth year of the reign of Tiberius, aged above ſeventy. Some ſay, he died on the ſame day with Ovid: it is certain that he died the ſame year.

Scarce any man was ever more honoured, alive as well as dead, than this hiſtorian. Pliny the younger relates, that a native gentleman travelled from Gades, in the extremeſt parts of Spain, to ſee Livy: and, though Rome abounded with more ſtupendous and curious ſpectacles than any city in the world, yet he immediately returned; as if, after having ſeen Livy, nothing farther could be worthy of his notice. A monument was erected to this hiſtorian in the temple of Juno, where was afterwards founded the monaſtery of St Juſtina. There, in 1413, was diſcovered the following epitaph upon Livy: *Oſſa Titi Livii Patavini, omnium mortalium judicio digni, cujus prope invicto calamo invicti populi Romani res geſtæ conſcriberentur;* that is, "The bones of Titus Livius of Patavium, a man worthy to be approved by all mankind, by whoſe almoſt invincible pen the acts and exploits of the invincible Romans were written." Theſe bones are ſaid to be preſerved with high reverence to this day, and are ſhown by the Paduans as the moſt precious remains. In 1451, Alphonſus, king of Arragon, ſent his ambaſſador, Anthony Panormita, to deſire of the citizens of Padua the bone of that arm with which their famous countryman had written his hiſtory; and, obtaining it, cauſed it to be conveyed to Naples with the greateſt ceremony as a moſt invaluable relic. He is ſaid to have recovered from an ill ſtate of health by the pleaſure he found in reading this hiſtory: and therefore, out of gratitude, put upon doing extraordinary honours to the memory of the writer. Panormita alſo, who was a native of Palermo in Sicily, and one of the ableſt men of the 15th century, ſold an eſtate to purchaſe this hiſtorian. Livius.

The hiſtory of Livy, like other great works of antiquity, is tranſmitted down to us exceedingly mutilated and imperfect. Its books were originally a hundred and forty-two, of which are extant only thirty-five. The epitomes of it, from which we learn their number, all remain, except thoſe of the 136th and 137th books. Livy's books have been divided into decades, which ſome will have to have been done by Livy himſelf, becauſe there is a preface to every decade; while others ſuppoſe it to be a modern contrivance, ſince nothing about it can be gathered from the ancients. The firſt decade, beginning with the foundation of Rome, is extant, and treats of the affairs of 460 years. The ſecond decade is loſt; the years of which are ſeventy-five. The third decade is extant, and contains the ſecond Punic war, including eighteen years. It is rekoned the moſt excellent part of the hiſtory, as giving an account of a very long and ſharp war, in which the Romans gained ſo many advantages, that no arms could afterwards withſtand them. The fourth decade contains the Macedonian war againſt Philip, and the Aſiatic war againſt Antiochus, which take up the ſpace of about 23 years. The five firſt books of the fifth decade were found at Worms, by Simon Grynæus, in 1431, but are very defective; and the remainder of Livy's hiſtory, which reaches to the death of Druſus in Germany in 746, together with the ſecond decade, are ſupplied by Freinſhemius.

Never man perhaps was furniſhed with greater advantages for writing a hiſtory than Livy. Beſides his own great genius, which was in every reſpect admirably formed for the purpoſe, he was trained as it were in a city, at that time the empreſs of the world, and in the politeſt reign that ever was; having ſcarcely had any other ſchool than the court of Auguſtus. He had acceſs to the very beſt materials, ſuch as the Memoirs of Sylla, Cæſar, Labienus, Pollio, Auguſtus, and others, written by themſelves. "What writers of memorials (ſays Lord Bolinbroke), what compilers of the Materia Hiſtorica, were theſe! What genius was neceſſary to finiſh up the pictures that ſuch maſters had ſketched! Rome afforded men that were equal to the taſk. Let the remains, the precious remains, of Salluſt, of Livy, and of Tacitus, witneſs this truth.—— What a ſchool of public and private virtue had been opened to us at the reſurrection of learning, if the latter hiſtorians of the Roman commonwealth, and the firſt of the ſucceeding monarchy, had come down to us entire! The few that are come down, though broken and imperfect, compoſe the beſt body of hiſtory that we have; nay, the only body of ancient hiſtory that deſerves to be an object of ſtudy. It fails us indeed moſt at that remarkable and fatal period, where our reaſonable curioſity is raiſed the higheſt. Livy employed forty-five books to bring his hiſtory down to the end of the ſixth century, and the breaking out of the third Punic war: but he employed ninety-five to bring it down from thence to the death of Druſus; that is, through the courſe of 120 or 130 years. Appian, Dion Caſſius, and others, nay, even Plutarch included, make us but poor amends for what is loſt of Livy." Speaking then of Tully's orations and letters, as the beſt

Livius.

best adventitious helps to supply this loss, he says, that "the age in which Livy flourished, abounded with such materials as these: they were fresh, they were authentic: it was easy to procure them; it was safe to employ them. How he did employ them in executing the second part of his design, we may judge from his execution of the first: and, I own, I should be glad to exchange, if it were possible, what we have of this history for what we have not. Would you not be glad, my Lord, to see, in one stupendous draught, the whole progress of that government from liberty to servitude; the whole series of causes and effects, apparent and real, public and private?" &c.

The encomiums bestowed upon Livy, by both ancients and moderns, are great and numerous. He not only entertains like Herodotus; he also instructs and interests in the deepest manner. But his great probity, candour, and impartiality, are what have distinguished Livy above all historians; for neither complaisance to the times, nor his particular connexions with the emperor, could restrain him from speaking well of Pompey; so well, as to make Augustus call him a *Pompeian*. This we learn from Cremutius Cordus, in Tacitus; who relates also, much to the emperor's honour, that this gave no interruption to their friendship. But whatever elogies Livy may have received as an historian, he has not escaped censure as a writer. In the age wherein he lived, Asinius Pollio charged him with Patavinity; which Patavinity has been variously explained by various writers, but is generally supposed to relate to his style. The most common is, that this noble Roman, accustomed to the delicacy of the language spoken in the court of Augustus, could not bear with certain provincial idioms, which Livy, as a Paduan, used in divers places of his history. Pignorius is of another opinion, and believes that this Patavinity regarded the orthography of certain words, wherein Livy used one letter for another, according to the custom of his country, writing *sibe* and *quase* for *sibi* and *quasi*; which he attempts to prove by several ancient inscriptions. The expressions, however, or the orthography of words, are not loaded with obscurity, and the perfect classic is as familiarly acquainted with those supposed provincialisms as with the purest Latinity.—Livy has been censured too, and perhaps with justice, for being too credulous, and burdening his history with vulgar notions and superstitious tales. He may disgust when he mentions that milk and blood were rained from heaven, or that an ox spoke or a woman changed her sex; yet he candidly confesses that he recorded only what made an indelible impression upon the minds of a credulous age.

Is it worth while to mention here the capricious and tyrannic humour of the emperor Caligula, who accused Livy of being a negligent and wordy writer, and resolved therefore to remove his works and statues out of all libraries, where he knew they were curiously preserved? Or the same humour in Domitian, another prodigy of nature, who put to death Metius Pomposianus, because he made a collection of some orations of kings and generals out of Livy's history? Pope Gregory the Great, also, would not suffer Livy in any Christian library, because of the Pagan superstition wherewith he abounded: but the same reason held good against all ancient authors; and indeed Gregory's zeal was far from being levelled at Livy in particular, the pontiff having declared war against all human learning.

Livius, Livonia.

Though we know nothing of Livy's family, yet we learn from Quintilian, that he had a son, to whom he addressed some excellent precepts in rhetoric. An ancient inscription speaks also of one of his daughters, named *Livia Quarta*: the same, perhaps, that espoused the orator Lucius Magius, whom Seneca mentions; and observes, that the applauses he usually received from the public in his harangues, were not so much on his own account, as for the sake of his father-in-law.

Our author's history has been often published with and without the supplement of Freinshemius. The best editions are, that of Gronovius, *cum notis variorum et suis*, Lugd. Bat. 1679, 3 vols 8vo; that of Le Clerc at Amsterdam, 1709, 10 vols 12mo; and that of Crevier, at Paris, 1735, 6 vols 4to. These have the supplements.—Learning perhaps never sustained a greater loss, in any single author, than by the destruction of the latter and more interesting part of Livy. Several eminent moderns have indulged the pleasing expectation that the entire work of this noble historian might yet be recovered. It has been said to exist in an Arabic version: and even a complete copy of the original is supposed to have been extant as late as the year 1631, and to have perished at that time in the plunder of Magdeburg. The munificent patron of learning, Leo X. exerted the most generous zeal to rescue from oblivion the valuable treasure, which one of his most bigotted predecessors, above mentioned, had expelled from every Christian library. Bayle has preserved, under the article Leo, two curious original letters of that pontiff, concerning his hopes of recovering Livy; which afford most honourable proofs of his liberality in the cause of letters.—A lately discovered fragment of Livy's history was published in 1773 by Dr Bruns.

Livius *Andronicus*, a comic poet who flourished at Rome about 240 years before the Christian era. He was the first who turned the personal satires and fescennine verses, so long the admiration of the Romans, into the form of a proper dialogue and regular play. Though the character of a player, so valued and applauded in Greece, was reckoned vile and despicable among the Romans, Andronicus acted a part in his dramatical compositions, and engaged the attention of his audience, by repeating what he had laboured after the manner of the Greeks. Andronicus was the freedman of M. Livius Salinator, whose children he educated. His poetry was grown obsolete in the age of Cicero, whose nicety and judgement would not even recommend the reading of it.

LIVONIA, a large province of the Russian empire, with the title of a duchy. It is bounded on the north by the gulf of Finland, on the west by that of Riga, on the south by Courland, and on the east, partly by Plescow, and partly by Novogorod. It is about 250 miles from north to south, and 150 from east to west. The land is so fertile in corn, that it is called the *granary of the north*: and would produce a great deal more, if it was not so full of lakes. The fish that abound here are salmons, carps, pikes, flat fish, and many others. In the forests there are wolves, bears, elks, rein-deer, stags, and hares. The domestic animals are very numerous; but the sheep bear very bad wool. Here are a great number

number of forests, which consist of birch trees, pines, and oaks; and all the houses of the inhabitants are built with wood. The merchandises which they send abroad are flax, hemp, honey, wax, leather skins, and potashes. The Swedes were formerly possessed of this province, but were obliged to abandon it to the Russians after the battle of Pultowa; and it was ceded to them by the peace of the north, concluded in 1722, which was confirmed by another treaty in 1742. It is divided into two provinces, viz. Letonia and Estonia; and two islands called *Oesel* and *Dagho*, which are again subdivided into several districts.

LIVONICA-TERRA, a kind of fine bole used in the shops of Germany and Italy. It is found in Livonia, from whence it takes its name. It is in the form of little cakes.

LIVRE, a French money of account, containing 20 sols. See *Money-Table*.

LIXA, or LIXUS, in *Ancient Geography*, a town on the Atlantic near the river Lixus; made a Roman colony by Claudius Cæsar; famous in mythology for the palace of Antæus and his encounter with Hercules, (Pliny). Now *Larache*, 65 leagues to the south of the straits of Gibraltar.

LIXIVIOUS, an appellation given to salts obtained from burnt vegetables by pouring water on their ashes.

LIXIVIUM, in *Pharmacy*, &c. a ley obtained by pouring some liquor upon the ashes of plants; which is more or less powerful, as it has imbibed the fixed salts contained in the ashes.

LIXNAW, a barony in the county of Kerry and province of Munster in Ireland, which gives title of baron to the earls of Kerry; the village here of this name being their ancient seat, where the castle was erected. This seat stands agreeably on the river Brick, which is here cut into several pleasant navigable canals, that adorn its plantations and gardens. W. Long. 9. 15. N. Lat. 52. 15.

LIZARD. See LACERTA, ERPETOLOGY *Index*.

LIZARD, in *Geography*, a cape or promontory of Cornwall, situated, according to the most common computation, in W. Long. 5. 47. N. Lat. 49. 50.

LLANDAFF. See LANDAFF.

LLOYD, WILLIAM, a most learned English writer and bishop, was born in Berkshire in England in 1627. He was educated under his father, rector of Sonning, and vicar of Tyle-hurst in Berkshire; then went to Oxford, and took orders. In 1660 he was made prebendary of Rippon; and in 1666 chaplain to the king. In 1667 he took the degree of doctor of divinity, in 1672 he was installed dean of Bangor; and in 1680 was consecrated bishop of St Asaph. He was one of the six bishops who, with Archbishop Sancroft, were committed prisoners to the Tower of London, for subscribing a petition to the king against distributing and publishing his declaration for liberty of conscience. Soon after the revolution he was made almoner to King William and Queen Mary: in 1692 he was translated to the bishopric of Litchfield and Coventry; and in 1699, to the see of Worcester, where he sat till his death, which happened in 1717, the 91st year of his age. Dr Burnet gives him an exalted character, and his works are highly esteemed.

LOACH. See COBITIS, ICHTHYOLOGY *Index*.

LOAD, or LODE, in mining, a word used especially in the tin-mines, for any regular vein or course, whether metallic or not; but most commonly load means a metallic vein. When the substances forming these loads are reducible to metal, the loads are by the English miners said to be alive; otherwise they are termed dead loads.

In Cornwall and Devonshire the loads chiefly hold their course from eastward to westward, though in other parts of England they frequently run from north to south. See VEINS, GEOLOGY *Index*.

LOAD is also used for nine dishes of ore, each dish being about half a hundred weight.

LOADSTONE. See MAGNET.

LOAMS, in *Natural History*, are defined to be earths composed of dissimilar particles, stiff, dense, hard, and rough to the touch; not easily broke while moist, readily diffusible in water, and composed of sand and a tough viscid clay. Of these loams some are whitish, and others brown and yellow.

LOAN, any thing given to another, on condition of return or payment.

Public Loans. See FUNDS and *NATIONAL Debt*.

LOANDA, a province of the kingdom of Angola in Africa. It is an island about 15 miles in length, and three in breadth; remarkable chiefly for the capital of Angola situated upon it, in E. Long. 12. 25. S. Lat. 8. 45. This town was built by the Portuguese in 1578, under the direction of the first Portuguese governor in these parts. It is large, populous, and pleasantly seated on the declivity of a hill near the sea-coast, and facing the south-west. The island is supplied with fresh water from wells dug in it; and which are not sunk below the depth of three feet when they are filled with excellent water. It is remarkable, however, that the water of these wells continues good only during the time of high tide; for, as that sinks, the water becomes more and more brackish, till at last it is quite salt, almost as much as the sea itself. On the coast of this island are fished the zimbis, or shells used in several parts of Africa instead of money; and with these shells, instead of coin, is carried on a great part of the traffic of this country.

LOANGO, a kingdom of Africa, extending itself about 180 geographical miles in length from south to north; that is, from Cape St Catherine under the second degree of south latitude, to a small river called *Lovanda Louisa*, on the 5th degree of the same. From west to east it extends from Cape Negro on the coast of Ethiopia towards the *Buckumalean* mountains, so called on account of their vast quantity of ivory and great droves of elephants, about 300 miles. It is divided into four principal provinces, viz. those of Lovangiri, Loango-mongo, Chilongo, and Piri.

The inhabitants are very black, well shaped, and of a mild temper. The men wear long petticoats, from the waist downwards, and have a piece of cloth round their waist. The women's petticoats are made of straw.

This country abounds with poultry, oxen, cows, sheep, goats, elephants, tigers, leopards, civet-cats, and other animals; so that here are great quantities of elephants teeth, and fine furs, to be traded for.

The capital city, where the king resides, called *Loango*, and, in the language of the negroes, *Boaric*, is situated in South Lat. $4\frac{1}{2}$ degrees, a league and a half

from

from the sea-coast, and is shaded and adorned with bananas, and other trees. The king, who resides in a large palace in the middle of it, has about 1500 concubines. If any of them is surprised in adultery, she and her paramour are instantly conveyed to the top of a very high hill, whence they are hurled down headlong from the steepest place.

Every man marries as many wives here as he pleases, who are obliged to get their husbands a livelihood, as is the practice all along the African coast inhabited by blacks. The women, therefore, cultivate the land, sow and reap, while the lazy husbands loiter away their time in idleness.

The king's revenue consists in elephants teeth, copper, and a kind of petticoats made of palm-tree leaves, and called *lavogus:* he has whole store-houses full of these lavogus; but his greatest riches consist in slaves of both sexes.

LOBBY, in *Architecture*, is a small hall or waiting-room: it is also an entrance into a principal apartment, where there is a considerable space between that and a portico or vestibule, and the length or dimensions will not allow it to be considered as a vestibule or an antiroom. See ANTICHAMBER.

LOBE, in *Anatomy*, any fleshy protuberant part, as the lobes of the lungs, the lobes of the ears, &c.

LOBELIA, CARDINAL-FLOWER; a genus of plants belonging to the syngenesia class; and in the natural method ranking under the 29th order, *Campanaceæ*. See BOTANY *Index*.

LOBETUM, anciently a town of the Hither Spain: said to have been built by the Libyan Hercules, (Pliny). Now *Albarazin*, a town of Arragon on the confines of New Castile, on the river Guadalavir. E. Long. 2. N. Lat. 40. 40.

LOBO, JEROME, a Jesuit missionary, was born at Lisbon in the year 1593. He became a member of the Jesuit society at 16 years of age, and in 1622 went out as a missionary to the East Indies. He sailed to the coast of Mozambique, after making some stay at Goa; and afterwards penetrated into Abyssinia, where his zeal and resolution brought on him the hatred of the monks, from which he incurred much danger and suffering. As he returned to Portugal he was shipwrecked on the coast of Natal, where seven months were spent in constructing shallops to bring them away. One of them foundered, but that in which Father Lobo sailed arrived safe at Angola. After a variety of adventures he arrived at Lisbon; and he employed himself in the cause of the Ethiopian mission both at Madrid and Rome. He took a second voyage to the Indies, where he was made rector of the house at Goa. He returned to Lisbon in 1658, and was chosen rector of the college of Coimbra, where he died in 1678, at the age of 84.

Lobo wrote an historical account of Abyssinia in the Portuguese language, which contains information both curious and valuable. It was translated into French by the abbé le Grand in 4to, in 1728; and the earliest production of Dr Samuel Johnson was an abridged version of this work.

LOBSTER, a species of cancer. See CANCER, ENTOMOLOGY *Index*.

LOCAL, in *Law*, something fixed to the freehold, or tied to a certain place; thus, real actions are local, since they must be brought in the country where they lie; and local customs are those peculiar to certain countries and places.

LOCAL *Medicines*, those destined to act upon particular parts; as fomentations, epithems, vesicatories, &c.

LOCARNO, a town of Swisserland, capital of a bailiwick of the same name, seated at the north end of the lake Maggiore, near the river Magie. It carries on a great trade; and the country abounds in pastures, wine, and fruits. E. Long. 8. 41. N. Lat. 46. 6.

LOCHABER, a district of the shire of Inverness in Scotland. It is bounded by Moydart on the west, Glengary on the north, Badenoch on the east, and Lorn on the south. It derives its name from the lake or loch Aber; and extends about 20 miles from east to west, and 30 from north to south. The country is barren, bleak, mountainous, and rugged. Near the mouth of the river Aber, in the centre between the West and North Highlands, stands Fort William, with the town of Maryburgh, built upon a navigable arm of the sea, not far from the foot of *Benevis*. The town, designed as a sutlery for the garrison, was erected into a borough; and the fort itself was designed as a check upon some of the clans, who had been guilty of depredations and other irregularities. Lochaber is inhabited mostly by the Macdonalds, Camerons, and Mackintoshes. The castle of Macdonald of Glengary, in this district, was burnt to the ground in the year 1715, in consequence of his declaring for the Pretender. The elegant house and gardens belonging to Cameron of Lochiel underwent the same fate, for the same reason, in the year 1746.

LOCHIA, in *Midwifery*, a flux from the uterus consequent to delivery. See MIDWIFERY.

LOCK, a well-known instrument used for fastening doors, chests, &c. generally opened by a key.

The lock is reckoned the masterpiece in smithery; a great deal of art and delicacy being required in contriving and varying the wards, springs, bolts, &c. and adjusting them to the places where they are to be used, and to the various occasions of using them.

From the various structure of locks, accommodated to their different intentions, they acquire various names. Those placed on outer doors are called *stock-locks;* those on chamber doors, *spring-locks;* those on trunks, *trunk-locks*, *pad-locks*, &c.

Of these the spring-lock is the most considerable, both for its frequency and the curiosity of its structure. Its principal parts are, the main-plate, the cover-plate, and the pin-hole: to the main-plate belong the key-hole, top-hook, cross-wards, bolt-toe or bolt-knab, drawback-spring tumbler, pin of the tumbler, and the staples; to the cover-plate belong the pin, main-ward, cross-ward, step-ward or dap-ward; to the pin-hole belong the hook-ward, main cross-ward, shank, the pot or bread, bow-ward, and bit.

As on the proper construction of locks the security of the most valuable kinds of property almost entirely depends, and as numberless devices are continually fallen upon to elude the utmost efforts of mechanical invention in this respect, it thence becomes an object of no small importance to invent a lock which it should be *impossible* to open except by its proper key. A treatise upon this subject has been published by Mr Joseph

ſeph Bramah; who is confident that he has brought the matter to the requiſite perfection, and that every one may reſt aſſured of the ſecurity of his property when under the protection of a lock of his invention. He begins with obſerving, that the principle on which all locks depend, is the application of a lever to an interior bolt, by means of a communication from without; ſo that, by means of the latter, the lever acts upon the bolt, and moves it in ſuch a manner as to ſecure the lid or door from being opened by any pull or puſh from without. The ſecurity of locks in general therefore depends on the number of impediments we can interpoſe betwixt the lever (the key) and the bolt which ſecures the door; and theſe impediments are well known by the name of *wards*, the number and intricacy of which alone are ſuppoſed to diſtinguiſh a good lock from a bad one. If theſe wards, however, do not in an effectual manner preclude the acceſs of *all* other inſtruments beſides the proper key, it is ſtill poſſible for a mechanic of equal ſkill with the lock-maker to open it without the key, and thus to elude the labour of the other.

"Locks (ſays our author) have been conſtructed, and are at preſent much uſed and held in great eſteem, from which the picklock is excluded: but the admiſſion of falſe keys is an imperfection for which no lock-ſmith has ever found a corrective; nor can this imperfection be remedied whilſt the protection of the bolt is wholly confided to *fixed wards*." This poſition is proved by a remark, that the wards, let them be as intricate as we pleaſe, muſt all be expreſſed on what is called the *bit* or *web* of the key: and therefore, when all the varieties that can be expreſſed on this bit or web have been run through, every ſucceeding lock muſt be the counterpart of ſome other; and conſequently the ſame key which opens one will open the other alſo. This is evident from the locks uſually put upon drawers; and which, though they ſhould be made to reſiſt the picklock, are ſtill liable to be opened by ten thouſand other keys beſides that appropriated to each of them. But though the variety of wards could be augmented even to infinity, ſtill there could be no ſecurity againſt falſe keys; for as every one of the wards muſt be expreſſed on the web of the key, if another key with a web quite plain be made to fit the key-hole exactly, we have only to cover it over with ſome colouring ſubſtance upon which the wards may make an impreſſion; after which, it is eaſy to cut out the web in a proper manner for admitting them, when the lock will be as eaſily opened by the falſe as by the true key.

The firſt perſon, according to our author, who had any claim to merit in the branch of lock-making, is Mr Baron; whoſe lock he acknowledges to be by far more perfect and ſecure than any that ever appeared before; though he ſtill conſiders it as unfit for giving that abſolute ſecurity which is to be wiſhed for. His improvement conſiſted in the proper application of what are called *tumblers*. "Theſe (ſays Mr Bramah) are a kind of grapple; by which the bolt is confined, as well in its active as in its paſſive ſtation, and rendered immoveable till ſet at liberty by the key. One of theſe inſtruments is commonly introduced into all locks that are of any uſe or value; it is lodged behind the bolt, and is governed by a ſpring which acts upon the tumbler as the tumbler acts upon the bolt: The application therefore of any force to the tumbler, which is ſuperior to the force of the ſpring, will cauſe it to quit its hold, and ſet the bolt at liberty." In the common method of applying theſe machines, however, it matters nothing how far the tumbler is lifted above the point at which it ceaſes to controul the bolt; but it is otherwiſe in thoſe of Mr Baron's conſtruction. The action of his tumblers is circumſcribed by a certain ſpace cut in the centre of the bolt, of dimenſions ſufficient only to anſwer the purpoſe intended. The ſpace in which the tumbler moves is an oblong ſquare; and is not only furniſhed with niches on the under ſide, into which the hooks of the tumblers are forced by the ſpring as in other locks, but is provided with correſpondent niches on the other ſide, into which the hooks are driven, if any greater force be applied to the tumblers than what is juſt ſufficient to diſengage them from the bolt. Hence it becomes abſolutely neceſſary, in the making of a falſe key, to conſtruct it in ſuch a manner, that it may with the greateſt exactneſs give the requiſite degree of preſſure, and no more.

Mr Bramah allows that this is a very great improvement, but objects that it is ſtill poſſible to frame a key which will open it as well as its own; nor will the addition of any number of tumblers preclude the poſſibility of opening it. "By giving (ſays he) an uniform motion to the tumblers, and preſenting them with a face which exactly tallies with the key, they ſtill partake, in a very great degree, of the nature of *fixed wards;* and the ſecurity of this lock is thereby rendered in a proportionable degree defective. Thus, ſuppoſe the falſe key to have paſſed the wards, and to be in contact with the moſt prominent of the tumblers, the impreſſion, which the ſlighteſt touch will leave on the key, will direct the application of the file till ſufficient ſpace is prepared to give it a free paſſage. The key will then bear upon a more remote tumbler; which difficulty being in like manner got over, the lock will be as eaſily opened by the falſe as by the true key."

This ſeemingly inſuperable objection to the perfection of lock-making, however, our author removes with the greateſt eaſe imaginable, by cauſing the tumblers which project unequally to preſent a *plane* ſurface: whence they would require a ſeparate and unequal motion to diſengage them; of conſequence no diſtinct impreſſion could be made by them upon the plane ſurface of the web that would give any idea of their poſitions with regard to one another, and the conſtruction of a falſe key would be altogether impoſſible.

But though the principal difficulty with regard to Mr Baron's lock be now overcome, others ſtill occur, viz. the difficulty of making locks which are conſtructed with tumblers ſufficiently durable. The tumblers themſelves, he obſerves, muſt be but ſlightly made; and being expoſed to perpetual friction by the key and their own proper motion, they muſt ſoon decay; and the keys of Mr Baron's locks, he alſo obſerves, are much leſs durable than thoſe of any other locks he ever ſaw.

With regard to the lock which Mr Bramah preſents to the public as abſolutely perfect, he informs us, that the idea of conſtructing it was firſt ſuggeſted by the alarming increaſe of houſe robberies, which may reaſonably be ſuppoſed to be perpetrated in a great

meaſure

Lock.

meafure by perfidious fervants, or accomplifhed by their connivance. Thus it is evident, that the locks which might exclude ordinary houfebreakers could be no fecurity againft faithlefs fervants, who having conftant accefs to the locks, might eafily get falfe keys fabricated at their leifure. In confidering the fubject, our author was convinced, that his hope of fuccefs depended entirely upon his ufing means as diffimilar as poffible to thofe by which the old locks were conftructed; as thefe, however varied, had been found infufficient for the purpofe. "As nothing (fays he) can be more oppofite in principle to *fixed wards* than a lock which derives its properties from the *motion* of all its parts, I determined that the conftruction of fuch a lock fhould be the fubject of my experiment." In the profecution of this experiment he had the fatisfaction to find, that the leaft perfect of all his models fully afcertained the truth and certainty of his principle. The exclufion of wards made it neceffary to cut off all communication between the key and the bolt; as the fame paffage, which (in a lock *fimply* conftructed) would admit the key, might give admiffion likewife to other inftruments. The office, therefore, which in other locks is performed by the extreme point of the key, is here affigned to a lever, which cannot approach the bolt till every part of the lock has undergone a change of pofition. The neceffity of this change to the purpofes of the lock, and the abfolute impoffibility of effecting it otherwife than with the proper key, are the points to be afcertained; and this our author does in the following manner.

Plate CCXCVI.

Fig. 1. Shows Mr Bramah's firft attempt to conftruct a lock upon this principle: which, to his furprife, turned out complete and perfect. A reprefents a common axis on which the fix levers, croffing the face of the lock, are united as on a joint. Each of thefe refts upon a feparate fpring fufficiently ftrong to bear its weight; or, if depreffed by a fuperior force, to reftore it to its proper pofition when that force is removed. B reprefents a frame through which the levers pafs by feparate grooves, exactly fitted to their width, but of fufficient depth to allow them a free motion in a perpendicular direction. The part which projects from the oppofite fide of the joint A, and is inferted in the bolt C, is a lever to which two offices are affigned; one to keep the bolt in a fixed pofition, in the abfence of the key; the other, to give it its proper motion upon the application of the key. D is a circular platform turning upon a centre. On this the joint or carriage of the levers, and the fprings on which they reft, are fixed; and the motion of this platform impels the bolt, in either direction, by means of the lever which is projected from the joint A. The inviolable reftraint upon this lock, by which means it is fubjected only to the action of the key, is lodged in the part E, which is a thin plate, bearing at each extremity on a block, and having of courfe a vacant fpace beneath, equal in height to the thicknefs of the blocks on which it refts. By this plate the motion of the machine is checked or guided in the following manner: On the edge of the plate which faces the movement there are fix notches which receive the ends of the levers projecting beyond the frame B; and while they are confined in this manner the motion of the machine is fo totally fufpended as to defy every power of art to overcome.

To underftand in what manner the proper key of this lock overcomes thefe obftacles, it muft be obferved, that each lever has a notch on its extremity, and that thofe notches are difpofed as irregularly as poffible. To give the machine a capacity of motion, thefe notches muft be brought parallel to each other, and by a diftinct but unequal preffure upon the levers, be formed into a groove in a direct line with the edge of the plate E, which the notches are exactly fitted to receive. The leaft motion of the machine, while the levers are in this pofition, will introduce the edge of the plate into the groove; which, controuling the power of the fprings, will give liberty to the levers to move in a horizontal direction as far as the fpace between the blocks which fupport the plate E will admit, and which is fufficient to give the machine a power of acting on the bolt. The impoffibility of thus bringing the notches on the points of the levers into a direct line, fo as to tally with the edge of the plate E by any other means than the motion and impulfe of the key, is that which conftitutes the principal excellency of this lock.

The key (fig. 2.) exhibits fix different furfaces, againft which the levers are progreffively admitted in the operation of opening the lock: the irregularity of thefe furfaces fhows the unequal and diftinct degree of preffure which each lever requires to bring them to their proper bearings, in order to put the machine in motion. Hence it appears, that unlefs the various heights of the furfaces expreffed on the bit of the key are exactly proportioned to the feveral diftances neceffary to bring the notches into a ftraight line with each other, they muft remain immoveable; "and (fays our author) as one ftroke of a file is fufficient to caufe fuch a difproportion as will prove an infurmountable impediment to their motion, I may fafely affert, that it is not in art to produce a key or other inftrument, by which a lock, conftructed upon this principle, can be opened."

On this principle it would even be a matter of great difficulty for any workman, however fkilful, to conftruct a key for the lock when open to his infpection: "for the levers being raifed, by the fubjacent fprings, to an equal height in the frame B, prefent a *plane* furface; and confequently convey no direction that can be of any ufe in forming a tally to the *irregular* furface which they prefent when acting in fubjection to the key. Unlefs therefore we can contrive a method to bring the notches on the points of the levers in a direct line with each other, and to retain them in that pofition till an exact impreffion of the irregular furface, which the levers will then exhibit, can be taken; the workman will be unable to fit a key to the lock, or to move the bolt. This procefs muft be rendered extremely troublefome by means of the fprings; and if fuch difficulties occur, even when the lock is open to the infpection of a fkilful workman, much more muft we fuppofe it out of the power of one who has not accefs to the internal parts to make a falfe key to a lock of this kind.

Thefe difficulties render it neceffary in making locks of this kind not to fit the key to the lock, as is ufual in

Lock.

in other locks, but to fit the lock to the key. In this kind of lock, therefore, the key muſt be made firſt; and the inequalities upon the ſurface of the bit worked as chance or fancy may direct, without any reference to the lock. The key being thus completed, and applied to the ſurface of the levers, will, by a gentle preſſure, force them to unequal diſtances from their common ſtation in the frame B, and ſink their points to unequal depths into the ſpace beneath the plate E. While the levers are in this poſition, the edge of the plate E will mark the preciſe point at which the notch on each lever muſt be expreſſed. The notches being cut by this direction, the irregularity which appears when the levers reſume their ſtation in the frame B, and the inequality of the receſſes on the bit of the key, will appear as a ſeal and its correſponding impreſſion.

The following is a lock contrived upon the ſame principle, but more curious; and, in our author's opinion, more extenſively uſeful. Fig. 3. repreſents a circular block of metal divided from the centre into eight compartments, each containing a cell which forms a paſſage through the block, as is repreſented by the ſmall circles deſcribed on the flat ſurface A. In each of theſe cells two grooves are cut at oppoſite points, which open a communication with the centre at one point, and with the ſpherical ſurface of the block or barrel at the other. The ſmall circle, which marks the centre of the flat ſurface A, is the key-hole, which likewiſe forms a paſſage through the barrel in a parallel line with the cells which ſurround it. This figure repreſents the frame in which the active parts of the lock are depoſited.

Fig. 4. ſhows a ſpiral ſpring lodged in the bottom of each cell, and occupying one half of the ſpace, the other being filled with a ſlider reſting upon the ſpring, and repreſented by fig. 5. the office of theſe ſliders exactly correſponding with that of the levers in the lock already deſcribed. Thus, when lodged in their reſpective cells, they are ſuſtained, like the levers, by the elaſticity of the ſprings upon which they reſt, till a ſuperior power be applied; and they are again reſtored to their ſtations by the reaction of the ſprings when the weight is removed. The ſide B of each ſlider is projected beyond the circular ſurface, as repreſented fig. 6. in a manner ſimilar to the projection of the levers in the former lock beyond the curved frame in which they move. The point C is projected through the interior groove into the ſpace which forms the centre or key-hole, expreſſed on the flat ſurface A.

Fig. 7. repreſents the key. When this is applied, it muſt of courſe encounter theſe interior projections; and when preſſed forward, the indented ſpaces on its point being unequal, will force the ſliders to unequal diſtances from their bearers; bringing the notches expreſſed on their exterior projections in a direct line with each other, in a manner ſimilar to that by which the effect is produced upon the levers in the former lock. When the key is withdrawn, and the ſliders reſume their ſtations by the preſſure of the ſprings, the diſpoſition of the notches muſt be irregular in the ſame proportion that the indentations on the point of the key are unequal; and they muſt neceſſarily fall again into a ſtraight line when acted upon by the key.

Fig. 6. ſhows the barrel completely fitted for action. Its interior end is caped with a plate, which unites its compartments, and confines the ſprings and ſliders within the cells to which they belong. From that plate proceeds the point A, which repreſents the lever by which the bolt is projected or withdrawn, according to the direction in which the machine performs its revolution.

Fig. 8. ſhows the flat ſurface of a thin plate, correſponding in its office with the part C of the former lock. The ſpace cut in its centre is exactly fitted to the ſpherical ſurface of the barrel; the circle deſcribing its circumference, and the notches cut on its edge coinciding with the projections of the ſliders. The barrel, when encircled with this plate at the middle of its ſpherical ſurface, has its motion totally ſuſpended till the notches on the projections of the ſliders are forced, by the preſſure of the key, into a line with each other: a groove being thus formed on the ſpherical ſurface of the barrel parallel to, and coinciding with, the edge of the plate, the machine is at liberty to perform a revolution in any direction, but returns to its confined ſtate when the key is withdrawn.

The parts of the movement being thus united, the interior end of the barrel is depoſited in a bed repreſented fig. 9. To this it is faſtened at the angles of the plate repreſented fig. 8. by which the barrel is encircled. The ſtation of the bolt is at A; the lever which acts upon it being projected on the other ſide. Fig. 10. is a cap or maſk which covers the face of the movement, and completes the lock.

On this lock our author obſerves, that it is excellent for ſtreet doors: "for no method of robbery (ſays he) is more practiſed, than gaining admittance into houſes by thoſe keys, which as is well known, may be procured at the old iron ſhops to fit almoſt any lock in uſe. Such robberies are generally committed where the ſervants are allowed to take the key with them when ſent on errands, it being impracticable while the key is fixed in the lock. The variations, by which the production of correſpondent keys is avoided, have two ſources: the one ariſing from the changes that may be made in the diſpoſition of the levers; the other from the number of points contained on the projected ſurface of each lever; by which the poſition of its notch may, in the ſmalleſt degree, be varied.

"The variations produceable in the diſpoſitions of ſix figures only, are 720: theſe, being progreſſively multiplied by additional figures, will increaſe by aſtoniſhing degrees; and eventually ſhow, that a lock containing twelve levers will admit of 479,001,500 changes; which, with the addition of another lever, will increaſe to 6,227,020,800. Theſe being again multiplied by the number of changes which the projected ſurface of the levers will admit in the diſpoſition of the notches, their amount will exceed numeration, and may therefore be properly ſaid to be infinite. The ſlighteſt inſpection will at once ſhow, that their conſtruction precludes all poſſibility of obtaining an impreſſion of their internal parts, which is neceſſary for the fabrication of a falſe key; for it will be eaſily ſeen, that the poſitions into which the levers are forced by the preſſure of the key in opening the lock, can no more be aſcertained when the key is withdrawn, than the ſeal can be copied from its impreſſion on a fluid, or the courſe of a ſhip be diſcovered by tracing it on the ſurface of the waves.

waves. But inviolable ſecurity is not the only excellence they poſſeſs; the ſimplicity of their principle gives them likewiſe a great advantage over locks that are more complicated, in point of duration; for their eſſential parts being ſubject to no friction, nor expoſed to any poſſible accident from without, they will be leſs affected by uſe, and leſs liable to ſtand in need of repair."

Lock, or *weir*, in inland navigations, the general name for all thoſe works of wood or ſtone made to confine and raiſe the water of a river: the banks alſo which are made to divert the courſe of a river, are called by theſe names in ſome places. But the term *lock* is more particularly appropriated to expreſs a kind of canal encloſed between two gates; the upper called by workmen the ſluice gate, and the lower called the flood gate. Theſe ſerve in artificial navigations to confine the water, and render the paſſage of boats eaſy in paſſing up and down the ſtream. See Canal.

LOCKE, John, an eminent Engliſh philoſopher and writer in the latter end of the 17th century, was ſon of Mr John Locke of Pensford in Somerſetſhire, and born at Wrington near Briſtol in 1632. He was ſent to Chriſt-church in Oxford; but was highly diſſatisfied with the common courſe of ſtudies then purſued in the univerſity, where nothing was taught but the Ariſtotelian philoſophy; and had a great averſion to the diſputes of the ſchools then in uſe. The firſt books which gave him a reliſh for philoſophy were the writings of Des Cartes: for though he did not always approve of his notions, yet he thought he wrote with great perſpicuity. He applied himſelf with vigour to his ſtudies, particularly to phyſic, in which he gained a conſiderable knowledge, though he never practiſed it. In 1664, he went to Germany as ſecretary to Sir William Swan, envoy from the Engliſh court to the elector of Brandenburg and ſome other German princes. In leſs than a year, he returned to England; where, among other ſtudies, he applied himſelf to that of natural philoſophy, as appears from a regiſter of the changes of the air, which he kept at Oxford from June 24. 1666, to March 28. 1667. There he became acquainted with the lord Aſhly, afterwards earl of Shafteſbury, who introduced him into the converſation of ſome of the moſt eminent perſons of that time. In 1670, he began to form the plan of his Eſſay on Human Underſtanding; but his employments and avocations prevented him from finiſhing it then. About this time he became a member of the Royal Society. In 1672, his patron, now earl of Shafteſbury, and lord chancellor of England, appointed him ſecretary of the preſentations, which place he held till the earl reſigned the great ſeal. In 1673, he was made ſecretary to a commiſſion of trade, worth 500l. a-year; but that commiſſion was diſſolved in 1674. The earl of Shafteſbury being reſtored to favour, and made preſident of the council in 1679, ſent for Mr Locke to London: but that nobleman did not continue long in his poſt, being ſent priſoner to the tower; and after his diſcharge retired to Holland in 1682.

Mr Locke followed his patron thither. He had not been abſent from England a year, when he was accuſed at court of having written certain tracts againſt the government, which were afterward diſcovered to be written by another perſon; and in November 1684, he was deprived of his place of ſtudent in Chriſt-church. In 1685, the Engliſh envoy at the Hague demanded him and 83 other perſons to be delivered up by the ſtates general: upon which he lay concealed till the year following; and during this time formed a weekly aſſembly with Mr Limborch, Mr Le Clerc, and other learned men at Amſterdam. In 1689 he returned to England in the fleet which conveyed the princeſs of Orange; and endeavoured to procure his reſtoration to his place of ſtudent of Chriſt-church, that it might appear from thence that he had been unjuſtly deprived of it: but when he found the college would admit him only as a ſupernumerary ſtudent, he deſiſted from his claim.

Being eſteemed a ſufferer for revolution principles, he might eaſily have obtained a more profitable poſt; but he contented himſelf with that of commiſſioner of appeals, worth 200l. a year, which was procured for him by the Lord Mordaunt; and about the ſame time he was offered an appointment in a diplomatic character, but the infirm ſtate of his health prevented him from accepting it. He went afterwards to reſide with Sir Francis Maſham and his lady, at Oates in Eſſex, about 25 miles from London, where he ſpent moſt of his time during the reſt of his life. In this agreeable ſituation he enjoyed that health and vigour which enabled him to exert his talents in writing on political ſubjects. Hence he appears in defence of the revolution in one piece; and conſidering the great national concern at that time, the ill ſtate of the ſilver coin, and propoſing remedies for it, in others. Hence he was made a commiſſioner of trade and plantations in 1695, which engaged him in the immediate buſineſs of the ſtate; and with regard to the church, he publiſhed a treatiſe the ſame year, to promote the ſcheme which King William had much at heart, of a comprehenſion with the diſſenters. This, however, drew him into one controverſy; which was ſcarcely ended, when he entered into another in defence of his eſſay, which held till 1698; ſoon after which the aſthma, his conſtitutional diſorder, increaſing with his years, began to ſubdue him; and he became ſo infirm, that in 1700 he reſigned his ſeat at the board of trade, becauſe he could no longer bear the air of London ſufficient for a regular attendance upon it. After this reſignation he continued altogether at Oates; in which retirement he employed the remaining laſt years of his life entirely in the ſtudy of the Holy Scriptures.

He died in 1704, aged 73. His writings will immortalize his name. The earl of Shafteſbury, author of the Characteriſtics, though in one place he ſpeaks of Mr Locke's philoſophy with ſeverity; yet obſerves, concerning his Eſſay on the Human Underſtanding, in general, "that it may qualify men as well for buſineſs and the world, as for the ſciences and the univerſity." His Diſcourſes on Government, Letters on Toleration, and Commentaries on ſome of St Paul's Epiſtles, are alſo held in much eſteem.

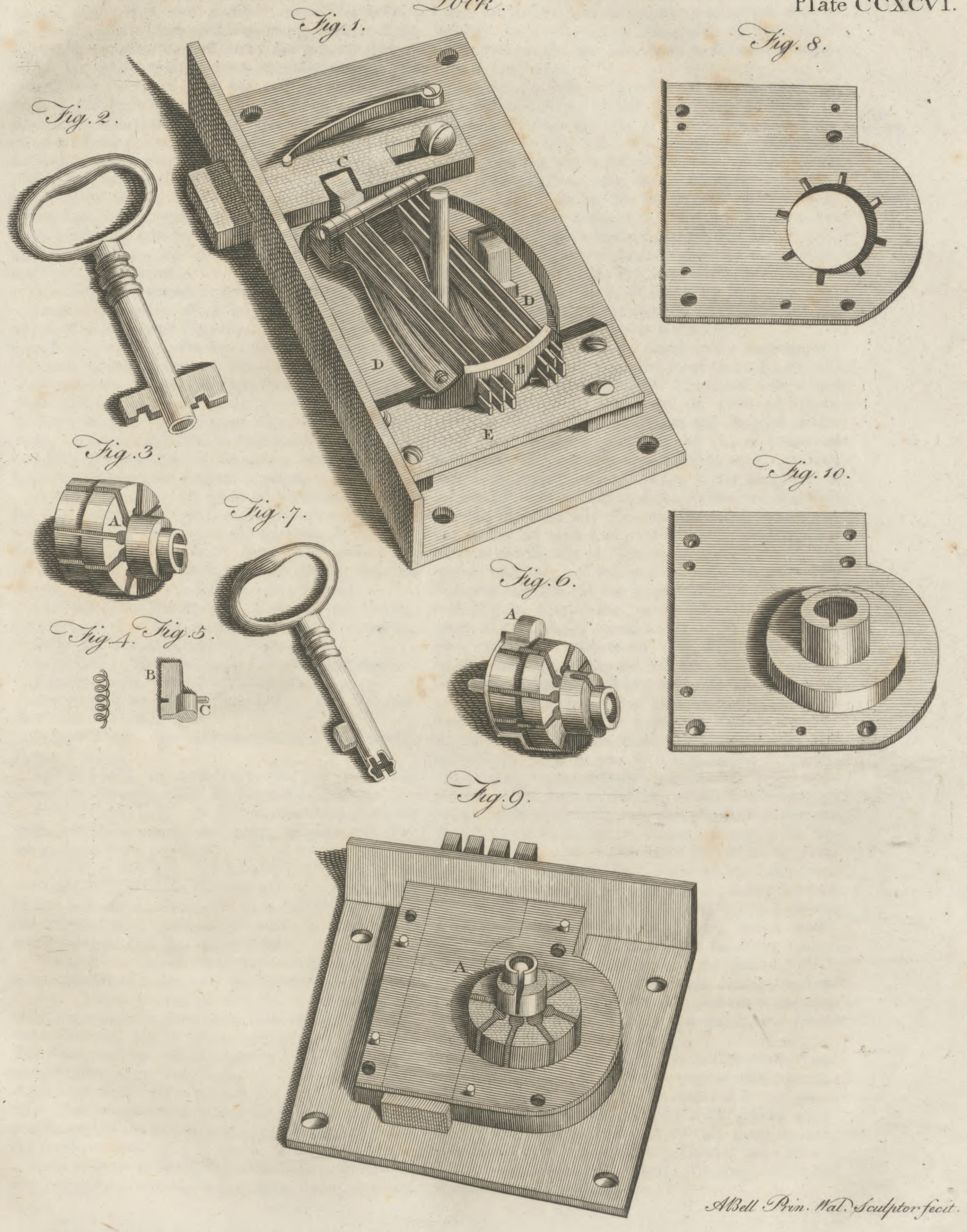
LOCKED jaw. See Medicine *Index*.

LOCKMAN, an officer in the Iſle of Man, who executes the orders of government, much like our under ſheriff.

Lockman, an eaſtern philoſopher. See Lokman.

LOCLE, a ſmall town in a diſtrict of the ſame name

Lock. Plate CCXCVI.



A. Bell Prin. Wal. Sculptor fecit.

name in Switzerland, adjacent to Neufchatel and Vallengin, and united with another named *La Ghaux de Fond*. Both these districts occupy some valleys formed by the mountains of Jura; the greatest part of which not many years ago was one continued forest, though now converted into fine pasture ground filled with flourishing villages. The inhabitants of these districts are remarkable for their industry, and excel in many mechanical arts, particularly in watch and clock making; 40,000 watches, it is said, are made in a year.

LOCRI, or *Locri Epizephyrii*, in *Ancient Geography*, a town on the Ionian sea near the promontory Zephyrium. The people were called *Locri* and *Locrenses*, and are said to be the first who used a code of written laws, compiled by Zaleucus from the laws of the Cretans and others.

LOCRIS, the district or territory of the Locri.

Locris, a country of Achaia in Greece; twofold, and divided by Mount Parnassus. The Hither was occupied by the Locri Ozolæ, called also *Zephyrii*, or Western, contained between Ætolia and Phocis. The Farther Locris lay beyond Parnassus, running out towards Thermopylæ, and reaching to the Euripus of Eubœa; occupied by the Locri Opuntii, and Epicnemidii, who were called the Eastern Locri.

LOCUS geometricus, denotes a line by which a local or indeterminate problem is solved.

A *locus* is a line, any point of which may equally solve an indeterminate problem. Thus if a right line suffice for the construction of the equation, it is called *locus ad rectum*; if a circle, *locus ad circulum*; if a parabola, *locus ad parabolam*; if an ellipsis, *locus ad ellipsin*: and so of the rest of the conic sections.

LOCULAMENTA, and Loculi, in *Botany*, cells or pockets: The internal divisions of a capsule, or other dry seed-vessel, enclosing the seeds.

LOCUST. See Gryllus, Entomology *Index*.

Locust-Eaters. See Acridophagi.

American Locust, or *Frog-hopper*. See Cicada, Entomology *Index*.

Locust-Tree. See Hymenæa and Gleditsia, Botany *Index*.

LOCUTIUS, in mythology, the god of speech among the Romans, called by Livy *Aius Locutius*.

LOCUTORIUM. A hall or apartment in monasteries where the monks and other religious met after dinner to converse together.

LODE, in *Mining*. See Load.

LODGMENT, in military affairs, a work made by the besiegers in some part of a fortification (after the besieged have been driven out), to maintain it, and be covered from the enemy's fire.

LOG, in the Jewish antiquities, a measure which held a quarter of a cab, and consequently five-sixths of a pint. There is mention of a log, 2 Kings vi. 25. under the name of a *fourth part of a cab*. But in Leviticus the word log is often met with, and signifies that measure of oil which lepers were to offer at the temple after they were cured of their disease. Dr Arbuthnot says, that the log was a measure of liquids, the seventy-second part of the bath or ephah, and twelfth part of the hin, according to all the accounts of the Jewish writers.

Log, a sea term, signifying a small piece of timber *a*, of a triangular, sectoral, or quadrantal figure, on board a ship, generally about a quarter of an inch thick, and five or six inches from the angular point to the circumference. It is balanced by a thin plate of lead, nailed to the arch, or circular side, so as to swim perpendicularly in the water.

Log-Line, a little cord, or line, about a hundred and fifty fathoms long, fastened to the log by means of two legs *a b* (fig. 4.), one of which passes through a hole at the corner, and is knotted on the opposite side, while the other leg is attached to the arch by a pin fixed into another hole, so as to draw out occasionally. By these legs the log is hung in equilibrio; and the line thus annexed to it is wound round a reel fixed for that purpose in the gallery of the ship. Plate CCXCVII.

This line, from the distance of about ten, twelve, or fifteen fathoms off the log, has certain knots or divisions, which ought to be at least fifty feet from each other; though it was the common practice at sea not to have them above forty-two feet asunder.

The length of each knot ought to be the same part of a sea mile as half a minute is of an hour; and admitting the measurement of Mr Norwood, who makes a degree on a great circle of the earth to contain 367,200 English feet, or about $69\frac{1}{2}$ English statute miles, and therefore $\frac{1}{60}$th part of it, or a nautical mile, will be 6120 feet; $\frac{1}{120}$th of 6120, or 51 feet, should be length of each knot. But because it is safer to have the reckoning rather before the ship than after it, therefore fifty feet may be taken as the proper length of each knot. The knots are sometimes made to consist only of forty-two feet each, even in the present practice; and this method of dividing the log-line was founded on the supposition that sixty miles, each of 5000 English feet, made a degree; for $\frac{1}{120}$ of 5000 is $41\frac{2}{3}$, or, in round numbers, 42 feet. Mariners, rather than quit the old way, though known to be erroneous, use glasses for half minute ones, that run but 24 or 25 seconds. They have also used a line of 45 feet to 30 seconds, or a glass of 28 seconds to 42 feet. When this is the case, the distance between the knots should be corrected by the following proportion: as 30 is to 50; so is the number of seconds of the glass to the distance between the knots upon the line. The heat or moisture of the weather has often a considerable effect upon the glass, so as to make it run slower or faster; it should, therefore, be frequently tried by the pendulum in the following manner. On a round nail hang a string that has a musket ball fixed to one end, carefully measuring between the centre of the ball and the string's loop over the peg $39\frac{1}{8}$ inches, being the length of a second pendulum; then swing it, and count one for every time it passes under the peg, beginning at the second time it passes and the number of swings made during the time the glass is running out shows the seconds it contains. The line also is liable to relax and shrink, and should therefore be occasionally measured.

The use of the log and line is to keep account and make an estimate of the ship's way or distance run; which is done by observing the length of line unwound in half a minute's time, told by a half-minute glass; for so many knots as run out in that time, so many miles the ship sails in an hour. Thus, if there be four knots veered out in half a minute, the ship is computed to run four miles an hour.

The

The author of this advice for meaſuring the ſhip's way is not known; and no mention of it occurs till the year 1607, in an Eaſt India voyge publiſhed by Purchas; but from that time its name occurs in other voyages among his collections; and henceforward it became famous, being taken notice of both by our own authors and by foreigners; as by Gunter in 1623; Snellius in 1624; Metius in 1631; Oughtred in 1633; Herigone in 1634; Saltonſtall in 1636; Norwood in 1637; Pournier in 1643; and almoſt by all the ſucceeding writers on navigation of every country.

To Heave the Log, as they call it, they throw it into the water on the lee ſide, letting it run till it comes without the eddy of the ſhip's wake; then one holding a half-minute glaſs, turns it up juſt as the firſt knot, or the mark from which the knots begin to be reckoned, turns off the reel (fig. 2.) or paſſes over the ſtern. As ſoon as the glaſs is out, the reel is ſtopped, and the knots run off are told, and their parts eſtimated.

It is uſual to heave the log once every hour in ſhips of war and Eaſt Indiamen, and in all other veſſels once in two hours, allowance being made for the wind having increaſed or abated in the intervals.

The log is a very precarious way of computing, and muſt always be corrected by experience, there being much uncertainty from the motions of the ſhip, the winds of variable force, the friction of the reel and lightneſs of the log in the courſe of the current. Yet this is a much more exact way of computing than any other in uſe; much preferable certainly to that of the Spaniards and Portugueſe, who gueſſed at the ſhip's way by the running of the froth or water by the ſhip's ſide; or to that of the Dutch, who uſed to heave a chip overboard, and to number the paces they walk on the deck while the chip ſwims between any two marks or bulk heads on the ſide.

Compound Log. The above-mentioned errors, and particularly the log's being ſubject to drive with the motion of the water at its ſurface, whereas the experiment requires it to be fixed in the place where it is when the mark commencing the knots goes off the reel, have been conſidered, and many methods propoſed to remove or to leſſen them. M. Bouguer propoſed the following method. Take for the log a conical piece of wood, which fix to the log line paſſed through or along its axis, at about 40, 50, or 60, or more feet, from one end; and to this end fix the diver, which is a body formed of two equal ſquare pieces of tin, or of thin iron plate, fixed at right angles to one another along their diagonals; and its ſize ſo fitted to that of the cone, that the whole may float. A cone of three inches diameter in the baſe, and of ſix inches in the ſlant height, is propoſed by M. Bouguer to ſuit a diver made of plates about $9\frac{3}{4}$ inches ſquare; the interſection of the diagonals is joined to the log line, and the loop and peg fixed as in the common log. However, it has been found, that no kind of wood uſed in Britiſh dock yards, when formed into a cone of the above dimenſions, will float a diver made of ſtout tin plates, one ſide of the ſquare being $9\frac{3}{4}$ inches. Such a diver weighing $1\frac{7}{8}$lb. avoirdupois, required to float it a cone of five inches diameter and twelve inches on the ſlant ſide, ſo as the point of the cone, which was made of light fir, ſhould juſt appear above the water. Now, ſuppoſing one ſide of ſuch a ſquare tin diver to be about ten inches, and made of plates only two-thirds of the thickneſs of the former, ſuch a diver would weigh, with its ſolder, about 20 ounces, and can be floated by a light fir cone of four inches diameter in the baſe, and ten inches in the ſlant height or length; and ſuch a compound log might perhaps be found on trial to be affected by about as much again as that propoſed by M. Bouguer; and conſequently the difference between the numbers given by the common log and compound log, muſt be augmented by two-thirds of itſelf for the neceſſary correction, as below. When the compound log of Bouguer, above deſcribed, is hove overboard, the diver will ſink too deep to be much affected by the current or motion of water at the ſurface, and the log will thereby keep more ſteadily in the place where it firſt fell; and conſequently the knots run off the reel will ſhow more accurately the ſhip's rate of ſailing. As the common log is affected by the whole motion of the current, ſo this compound log will feel only a part thereof, viz. ſuch a part nearly as the reſiſtance of the cone is to the reſiſtance of the diver; then the reſiſtances of the above cone and diver are about as 1 to 5; and conſequently this log will drive but one-fifth part of what the common log would do; and ſo the ſhip's true run will be affected by one-fifth only of the motion of the waters. To obtain the true rate of ſailing, it will be proper to heave alternately, hour and hour, the common log, and this compound log; then the difference of their knots run off, augmented by its one-fourth part, is the correction; which applied to the knots of the common log, will give the ſhip's true rate of ſailing at the middle time between the hours when theſe logs were hove. The correction is additive when the compound log's run is the greateſt, otherwiſe it is ſubtractive. To find the courſe made good: increaſe the obſerved angle between the log lines by one-fourth part; and this gives the correction to be applied to the apparent courſe, or the oppoſite of that ſhown by the common log; the correction is to be applied to the $\left\{\begin{matrix}\text{right}\\\text{left}\end{matrix}\right\}$ of the apparent courſe, when the bearing of the common log is to the $\left\{\begin{matrix}\text{left}\\\text{right}\end{matrix}\right\}$ of the compound log. Or thus: the lengths run off both logs, together with their bearings, being known; in a card or compaſs apply the knots run off, taken from a ſcale of equal parts along their reſpective bearings from the centre; join the ends; and in this line produced, on the ſide next the compound log's length, take one-fourth of the interval; then a line drawn from the end, thus produced, to the centre of the card, will ſhow the true courſe and diſtance made good. When a current, ſuch as a tide, runs to any depth, the velocity of that current may be much better aſcertained by the compound log than by the common one, provided the diver does not deſcend lower than the run of the current; for as thoſe ſhips which are deepeſt immerged, drive faſteſt with the tide; ſo the diver, by being acted on below, as well as the log on the ſurface, their joint motion will give the total effect of the current's motion better than what could be derived from the motion at the ſurface only. Alſo, by ſuch a compound log, the depth to which any current runs may be eaſily tried.

Mem. Acad. Scien. 1747.

Other Logs. We have an account in the voyage to the North

Plate CCXCVII.

Log.

Fig. 1.

Fig. 2.

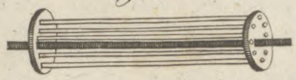


Fig. 3.

Fig. 4.

Logarithms.

Fig. 3.

Fig. 5.

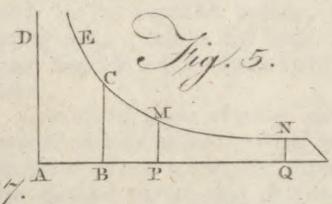


Fig. 6.

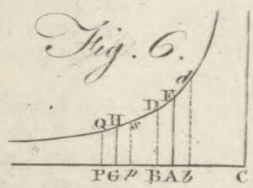


Fig. 7.

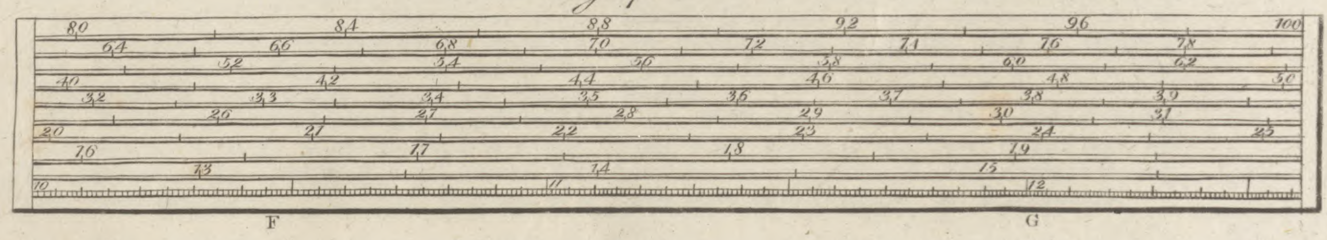


Fig. 8.

Fig. 9.

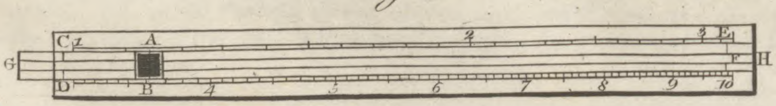


Fig. 10.

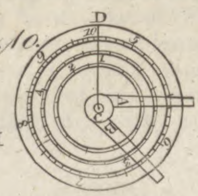
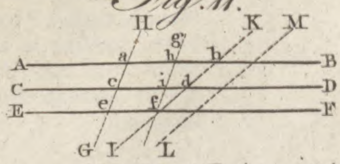


Fig. 11.



A. Bell Prim. Wal. Sculptor fecit.

North Pole, p. 97. of two other logs, which were tried by Captain Phipps: one invented by Mr Ruſſel, the other by Foxon; both conſtructed upon this principle, that a ſpiral, in proceeding its own length in the direction of its axis through a reſiſting medium, makes one revolution round the axis; if, therefore, the revolutions of the ſpiral are regiſtered, the number of times it has gone its own length through the water will be known. In both theſe the motion of the ſpiral in the water is communicated to the clockwork within board, by means of a ſmall line faſtened at one end to the ſpiral, which tows it after the ſhip, and at the other to a ſpindle, which ſets the clockwork in motion. That invented by Mr Ruſſel has a half ſpiral of two threads, made of copper, and a ſmall dial with clockwork, to regiſter the number of turns of the ſpiral. The other log has a whole ſpiral of wood with one thread, and a larger piece of clockwork with three dials, two of them to mark the diſtance, and the other divided into knots and fathoms, to ſhow the rate by the half minute glaſs, for the convenience of comparing it with the log. This kind of log will have the advantage of every other in ſmooth water and moderate weather; and it will be uſeful in finding the trim of a ſhip when alone, in ſurveying a coaſt in a ſingle ſhip, or in meaſuring diſtances in a boat between headlands and ſhoals; but it is ſubject to other inconveniences, which will not render it a proper ſubſtitute for the common log.

Perpetual Log, a machine ſo called by its inventor, Mr Gottlieb of London, is intended for keeping a conſtant and regular account of the rate of a ſhip's velocity in the interval of heaving the log.

Plate CCXCVII. Fig. 1. is a repreſentation of the whole machine; the lower part of which, EFG, is fixed to the ſide of the keel; H repreſenting only the boundary line of the ſhip's figure. EF are the ſection of a wooden external caſe, left open at the ends KL, to admit the paſſage of the water during the motion of the ſhip. At M is a copper grating, placed to obſtruct the entrance of any dirt, &c. into the machine. I is a ſection of a water wheel, made from 6 to 12 inches in diameter, as may be neceſſary, with floatboards upon its circumference, like a common water wheel, that turn by the reſiſtance of the water paſſing through the channel LK. It turns upon a ſhouldered axis, repreſented by the vertical ſection at K. When the ſhip is in motion, the reſiſtance of the water through the channel LK turns round the wheel I. This wheel, by means of a pinion, is connected with and turns the rod contained in the long copper tube N. This rod, by a pinion fixed at its upper extremity, is connected with and turns upon the whole ſyſtem of wheels contained in the dial of the caſe ABCD. This dial, by means of the copper tube N, may be fixed to any convenient place aboard the ſhip. In the front of the dial are ſeveral uſeful circular graduations, as follow: The reference by the dotted line A has a hand which is moved by the wheels within, which points out the motion of the ſhip in fathoms of 6 feet each. The circle at B has a hand ſhowing the knots, at the rate of 48 feet for each knot: and is to be obſerved with the half-minute glaſs at any time. The circle at C has a ſhort and a long hand; the former of which points out the miles in land meaſure, and the latter or longer the number of knots contained in each mile, viz. 128, which is in the ſame proportion to a mile as 60 minutes to the hour in the reckoning. At *e*, a ſmall portion of a circle is ſeen through the front plate called the *regiſter*; which ſhows, in the courſe of 24 hours (if the ſhip is upon one tack), the diſtance in miles that ſhe has run; and in the 24 hours the mariner need take but one obſervation, as this regiſter ſerves as an uſeful check upon the fathoms, knots, and miles, ſhown upon the two other circles.

f Is a plate ſhowing 100 degrees or 6000 miles, and alſo acts as another regiſter or check; and is uſeful in caſe of any miſtake being made in obſerving the diſtance run by the other circles. The reckoning by theſe circles, without fear of miſtake, may therefore be continued to nearly 12,000 miles.

A communication from this machine may eaſily be made to the captain's bedſide, where by touching a ſpring only, a bell in the head ABCD will ſound as many times in a half minute as the ſhip ſails miles in an hour.

Log-Board, a ſort of table, divided into ſeveral columns, containing the hours of the day and night, the direction of the winds, the courſe of the ſhip, and all the material occurrences that happen during the 24 hours, or from noon to noon; together with the latitude by obſervation. From this table the officers of the ſhip are furniſhed with materials to compile their journals.

Log-Book, a book into which the contents of the log-board is daily copied at noon, together with every circumſtance deſerving notice that may happen to the ſhip, either at ſea or in a harbour. See NAVIGATION.

LOGARITHMS.

INTRODUCTION.

THE labour and time required for performing the arithmetical operations of multiplication, diviſion, and the extraction of roots, were at one time conſiderable obſtacles to the improvement of various branches of knowledge, and in particular the ſcience of aſtronomy. But about the end of the 16th century, and the beginning of the 17th, ſeveral mathematicians began to conſider by what means they might ſimplify theſe operations, or ſubſtitute for them others more eaſily performed. Their efforts produced ſome ingenious contrivances for abridging calculations; but of theſe the moſt complete by far was that of *John Napier Baron of Merchiſton* in Scotland, who invented a ſyſtem of numbers called *logarithms*, which were ſo adapted to the numbers to be multiplied, or divided, that theſe being arranged in the form of a table, each oppoſite to the

number

Introduction.

number called its logarithm, the product of any two numbers in the table was found by the addition of their logarithms; and, on the contrary, the quotient ariſing from the diviſion of one number by another was found by the ſubtraction of the logarithm of the diviſor from that of the dividend; and ſimilar ſimplifications took place in the ſtill more laborious operations of involution and evolution. But before we proceed to relate more particularly the circumſtances of this invention, it will be proper to give a general view of the nature of logarithms, and of the circumſtances which render them of uſe in calculation.

Let there be formed two ſeries of numbers, the one conſtituting a geometrical progreſſion, the firſt term of which is unity or 1, and the common ratio any number whatever, and the other an arithmetical progreſſion, the firſt term of which is 0, and the common difference alſo any number whatever; (but as a particular example we ſhall ſuppoſe the common ratio of the geometrical ſeries to be 2, and the common difference of the arithmetical ſeries 1), and let the two ſeries be written oppoſite to each other in the form of a table, thus:

Geom. Prog.		Arith. Prog.
1	-	0
2	-	1
4	-	2
8	-	3
16	-	4
32	-	5
64	-	6
128	-	7
256	-	8
512	-	9
1024	-	10
2048	-	11
4096	-	12
&c.		&c.

The two ſeries being thus arranged, the terms in the arithmetical ſeries are called the *logarithms* of the correſponding terms of the geometrical ſeries; that is, 0 is the logarithm of 1, and 1 is the logarithm of 2, and 2 is the logarithm of 4, and 3 that of 8, and ſo on.

From the manner in which the two ſeries are related to each other, it will readily appear by induction that the logarithms of the terms of the geometrical ſeries have the two following properties:

1. The ſum of the logarithms of any two numbers or terms in the geometrical ſeries is equal to the logarithm of that number, or term of the ſeries, which is equal to their product.

For example, let the terms of the geometrical ſeries be 4 and 32; the terms of the arithmetical ſeries correſponding to them (that is, their logarithms) are 2 and 5; now the product of the numbers is 128, and the ſum of their logarithms is 7; and it appears by inſpection of the two ſeries, that the latter number is the logarithm of the former, agreeing with the propoſition we are illuſtrating. In like manner, if the numbers or terms of the geometrical ſeries be 16 and 64, the logarithms of which are 4 and 6, we find from the table that $10=4+6$ is the logarithm of $1024=16\times 64$; and ſo of any other numbers in the table.

2. The difference of the logarithms of any two numbers, or terms of the geometrical ſeries, is equal to the logarithm of that term of the ſeries which is equal to the quotient ariſing from the diviſion of the one number by the other.

Take for example the terms 128 and 32, the logarithms of which are 7 and 5; the greater of theſe numbers divided by the leſs is 4, and the difference of their logarithms is 2; and by inſpecting the two ſeries, this laſt number will be found to be the logarithm of the former. In like manner, if the terms of the geometrical ſeries be 1024 and 16, the logarithms of which are 10 and 4, we find that $1024\div 16=64$, and that $10-4=6$; now it appears from the table that the latter number, viz. 6, is the logarithm of the former 64.

Theſe two properties of logarithms, the ſecond of which indeed is an immediate conſequence of the firſt, enable us to find with great facility the product or the quotient of any two terms of a geometrical ſeries to which there is adapted an arithmetical ſeries, ſo that each number has its logarithm oppoſite to it, as in the preceding ſhort table. For it is evident, that to multiply two numbers we have only to add their logarithms, and oppoſite to that logarithm which is the ſum we ſhall find the product required. Thus, to multiply 16 by 128; to the logarithm of 16, which is 4, we add the logarithm of 128, which is 7, and oppoſite to the ſum 11, we find 2048, the product ſought. On the other hand, to divide any number in the table by any other number, we muſt ſubtract the logarithm of the diviſor from that of the dividend, and look for the remainder among the logarithms, and oppoſite to it we ſhall find the number ſought. Thus, to divide 2048 by 128, from 11, which is the logarithm of 2048 we ſubtract 7, the logarithm of 128, and oppoſite to the remainder 4 we find 16, the quotient ſought.

Let us now ſuppoſe any number of geometrical means to be interpoſed between each two adjoining terms of the preceding geometrical ſeries, and the ſame number of arithmetical means between every two adjoining terms of the arithmetical ſeries; then, as the reſults will ſtill be a geometrical and an arithmetical ſeries, the interpolated terms of the latter will be the logarithms of the correſponding terms of the former, and the two new ſeries will have the very ſame properties as the original ſeries.

If we ſuppoſe the number of interpolated means to be very great, it will follow that among the terms of the reſulting geometrical ſeries, ſome one or other will be found nearly equal to any propoſed number whatever. Therefore, although the preceding table exhibits the logarithms of 1, 2, 4, 8, 16, &c. but does not contain the logarithms of the intermediate numbers, 3, 5, 6, 7, 9, 10, &c. yet it is eaſy to conceive that a table might be formed by interpolation which ſhould contain, among the terms of the geometrical ſeries, all numbers whatever to a certain extent, (or at leaſt others very nearly equal to them) together with their logarithms. If ſuch a table were conſtructed, or at leaſt if ſuch terms of the geometrical progreſſion were found together with their logarithms, as were either accurately equal to, or coincided nearly with, all numbers

Introduction.

bers within certain limits, (for example between 1 and 100000) then, as often as we had occasion to multiply or divide any numbers contained in that table we might evidently obtain the products or quotients by the simple operations of addition and subtraction.

The first invention of logarithms has been attributed by some to *Longomontanus*, and by others to *Juste Byrge*, two mathematicians who were cotemporary with *Lord Napier;* but there is no reason to suppose that either of these anticipated him, for *Longomontanus* never published any thing on the subject, although he lived thirty-three years after *Napier* had made known his discovery; and as to *Byrge*, he is indeed known to have printed a table containing an arithmetical and a geometrical progression written opposite to each other, so as to form in effect a system of logarithms of the same kind as those invented by *Napier*, without however explaining their nature and use, although it appears from the title he intended to do so, but was probably prevented by some cause unknown to us. But this work was not printed till 1620, six years after Napier had published his discovery.

It is therefore with good reason that *Napier* is now universally considered as the first, and most probably as the only inventor. This discovery he published in the year 1614 in a book entitled *Mirifici Logarithmorum Canonis Descriptio*, but he reserved the construction of the numbers till the opinion of the learned concerning his invention should be known. His work contains a table of the natural sines and cosines, and their logarithms for every minute of the quadrant, as also the differences between the logarithmic sines and cosines, which are in effect the logarithmic tangents. There is no table of the logarithms of numbers; but precepts are given, by which they, as well as the logarithmic tangents, may be found from the table of natural and logarithmic sines.

In explaining the nature of logarithms, *Napier* supposes some determinate line which represents the radius of a circle to be continually diminished, so as to have successively all possible values, and thus to be equal to every sine, one after another, throughout the quadrant. And he supposes this diminution to be effected by a point moving from one extremity towards the other extremity, (or rather some point very near it), with a motion that is not uniform, but becomes slower and slower, and such, that if the whole time between the beginning and the end of the motion be conceived to be divided into a very great number of equal portions, the decrements taken away in each of these shall be to one another as the respective remainders of the line. According to this mode of conceiving the line to decrease, it is easy to shew that at the end of any successive equal intervals of time from the beginning of the motion, the portions of the line which remain will constitute a decreasing geometrical progression.

Again, he supposes another line to be generated by a point which moves along it equably, or which passes over equal intervals of it in equal times. Thus the portions of the line generated at the end of any equal successive intervals of time from the beginning of the motion will form a series of quantities in arithmetical progression. Now if the two motions be supposed to begin together, at the end of any equal intervals of time the remainders of the one line will form a series of quantities in geometrical progression, and the corresponding portions generated of the other line, will constitute a series in arithmetical progression, so that the latter will be the logarithms of the former. And as the terms of the geometrical progression decrease continually from radius, which is the greatest term, to 0, while the terms of the corresponding arithmetical progression increase from 0 upwards, according to Napier's system the logarithm of radius is 0, and the logarithms of the sines from radius down to 0, are a series of numbers increasing from 0 to infinite.

The velocities or degrees of quickness with which the motions commence may have to each other any ratio whatever, and by assuming different ratios we shall have different systems of logarithms. Napier supposed the velocities to be equal; but the system of logarithms produced in consequence of this assumption having been found to have some disadvantages, it has been long disused, and a more convenient one substituted instead of it, as we shall presently have occasion to explain.

Napier's work having been written in Latin was translated into English by *Mr Edward Wright*, an ingenious mathematician of that period, and the inventor of the principles of what is commonly though erroneously called *Mercator's sailing*. The translation was sent to Napier for his perusal, and returned with his approbation, and the addition of a few lines, intimating that he intended to make some alteration in the system of logarithms in a second edition. Mr Wright died soon after he received back his translation; but it was published after his death, in the year 1616, accompanied with a dedication by his son to the East India Company, and a preface by *Henry Briggs*, who afterwards distinguished himself so much by his improvement of logarithms. *Mr Briggs* likewise gave in this work the description and draught of a scale which had been invented by *Wright*, as also various methods of his own for finding the logarithms of numbers, and the contrary, by means of Napier's table, the use of which had been attended with some inconvenience on account of its containing only such numbers as were the natural sines to every minute of the quadrant and their logarithms. There was an additional inconvenience in using the table, arising from the logarithms being partly positive and partly negative; the latter of these was, however, well remedied by *John Speidell* in his *New Logarithms*, first published in the year 1619, which contained the sines, cosines, tangents, cotangents, secants, and cosecants, and given in such a form as to be all positive; and the former was still more completely removed by an additional table, which he gave in the sixth impression of his work, in the year 1624, and which contained the logarithms of the whole numbers 1, 2, 3, 4, &c. to 1000, together with their differences and arithmetical complements, &c. This table is now commonly called *hyperbolic logarithms*, because the numbers serve to express the areas contained between a hyperbola and its asymptote, and limited by ordinates drawn parallel to the other asymptote. This name, however, is certainly improper, as the same spaces may represent the logarithms of any system whatever, (see FLUXIONS § 152. Ex. 5.)

In 1719 *Robert Napier*, son of the inventor of logarithms, published a second edition of his father's *Logarithmorum Canonis Descriptio*. And along with this

Introduction.

this the promifed *Logarithmorum Canonis Conftructio*, and other pieces written by his father and Mr Briggs. An exact copy of the fame two works in one volume was alfo printed in 1620 at Lyons in France. In 1618 or 1619 *Benjamin Urfinus*, mathematician to the elector of Brandenburg, publifhed Napier's tables of logarithms in his *Curfus Mathematicus*, to which he added fome tables of proportional parts; and in 1624 he printed his *Trigonometria*, with a table of natural fines, and their logarithms of the Napierean kind and form, to every ten feconds of the quadrant.

In the fame year, 1624, the celebrated *John Kepler* publifhed at Marpurg logarithms of nearly the fame kind, under the title of *Chilias Logarithmorum ad totidem Numeros Rotundos, præmiffa Demonftratione legitima Ortus Logarithmorum eorumque Ufus*, &c. and in the following year he publifhed a fupplement to this work. In the preface to this laft he fays, that feveral of the profeffors of mathematics in Upper Germany, and more efpecially thofe of them who were fomewhat advanced in years, and were grown averfe to new methods of reafoning that carried them out of the old doctrines and principles with which habit had rendered them familiar, doubted in fome degree whether Napier's demonftration of the property of logarithms was perfectly true, and whether the application of them to trigonometrical calculations might not be unfafe and lead the calculator who fhould truft in them to erroneous refults; and in either cafe, whether the doctrine were true or not, they confidered Napier's demonftration of it as illegitimate and unfatisfactory This opinion induced *Kepler* to compofe the above-mentioned work, in which the whole doctrine is treated in a manner ftrictly geometrical, and free from the confiderations of motion which the German mathematicians had objected to (and not without reafon) in Napier's mode of treating the fubject.

On the publication of Napier's logarithms, *Mr Henry Briggs*, fome time profeffor of geometry in Grefham college London, and afterwards Savilian profeffor of geometry at Oxford (whom we have already mentioned) applied himfelf with great earneftnefs to their ftudy and improvement, and it appears that he had projected at an early period that advantageous change in the fyftem which has fince taken place. From the particular view which Napier took of the fubject, and the manner in which he conceived logarithms to be generated, it happened that in his fyftem, the logarithms of a feries of numbers which increafed in a decuple ratio, (as 1, 10, 100, 1000, &c.) formed a decreafing arithmetical feries, the common difference of the terms of which was 2.3025851. But it occurred to Briggs that it would be better and more conformable to the received decimal notation, to adopt a fyftem in which the logarithms of the terms of fuch a geometrical feries fhould differ from each other by unity or 1. This idea Briggs communicated to the public in his lectures, and alfo to Napier himfelf. He even went twice to Edinburgh to fee him, and to converfe with him upon the fubject; and on his firft vifit Napier faid that he had alfo formerly thought of the fame improvement, but that he chofe to publifh the logarithms he had previoufly calculated, till fuch time as his health and convenience would allow him to make others more commodious. And whereas in the change which Briggs propofed, it was intended to make the logarithms of the fines to increafe from 0 (the logarithm of radius) to infinity, while the fines themfelves fhould decreafe, it was fuggefted to him by Napier that it would be better to make them increafe fo that 0, inftead of being the logarithm of radius, fhould be the logarithm of 1; and that 100000, &c. fhould be the logarithm of radius; and this Briggs admitted would be an improvement; and having changed the numbers he had already calculated fo as to make them fuit Napier's modification of his plan, he returned with them next year to Edinburgh, and fubmitted them to his perufal.

Introduction.

It appears therefore that Briggs was the inventor of this improved fyftem of logarithms which has fince been univerfally adopted, and that the only fhare that Napier had in it was his fuggefting to Briggs to begin with the low number 1, and to make the logarithms, or the artificial numbers, as Napier had always called them, to increafe with the natural numbers, inftead of decreafing, which made no alteration in the figures, but only in their affections or figns, changing them from negative to pofitive.

On Briggs's return from Edinburgh, in 1617, he printed the firft thoufand logarithms to eight places of figures, befides the index, with the title of *Logarithmorum Chilias prima*; but thefe feem not to have been publifhed till after the death of Napier, which happened in 1618, for in his preface he expreffes a hope, that the circumftances which led to a change in the fyftem would be explained in Napier's pofthumous work, which was prefently to appear. But although Napier had intimated in a note he had given in Wright's tranflation of the *Canon Mirificus*, as well as his *Rabdologia*, printed in 1617, that he intended to alter the fcale, yet he altogether omits to ftate that Briggs either was the firft to think of this improvement, or at leaft to publifh it to the world. And as the fame filence on this point was obferved in Napier's pofthumous work publifhed in 1619 by his fon, Briggs took occafion in the preface to his *Arithmetica Logarithmica* to affert his claims to the improvement he had now carried into execution.

The ftudied filence which Napier feems to have obferved refpecting the improvement of the fyftem, which Briggs had communicated to him, has given juft reafon to fufpect that he wifhed to be confidered as the author of that improvement, as well as the original inventor. But although it is poffible that he thought of it as foon as Briggs, it would feem to have been no more than juftice, if, when announcing his intended change of the fcale, he had acknowledged that the fame idea had occurred to Briggs as well as to himfelf.

In 1620 *Mr Edmund Gunter* publifhed his *Canon of Triangles*, which contains the artificial or logarithmic fines and tangents to every minute to feven places of figures befides the index, the logarithm of radius being 10. Thefe logarithms are of the kind which had been agreed upon between Napier and Briggs, and they were the firft tables of logarithmic fines and tangents that were publifhed of this fort. Gunter alfo in 1623 reprinted the fame in his book *de Sectore et Radio*, together with the *Chilias prima* of Briggs; and in the fame year he applied the logarithms of numbers, fines, and tangents, to ftraight lines drawn upon a ruler. This inftrument is now in common ufe for navigation and other purpofes, and is commonly called *Gunter's fcale*.

The

Introduction.

The diſcoveries in Logarithms were firſt carried to France by *Mr Edmund Wingate*, but not firſt of all as he ſays in the preface to his book. He publiſhed at Paris in 1624 two ſmall tracts in the French language upon logarithms, and theſe were reprinted with improvements at London in 1626.

In the year 1624, Briggs publiſhed his *Arithmetica Logarithmica*, a ſtupendous work conſidering the ſhort time he had been in preparing it. He here gives the logarithms of 30000 natural numbers to fourteen places of figures, beſides the index; namely, from 1 to 20000, and from 90000 to 100000, together with the differences of the logarithms. He alſo gives an ample treatiſe on their conſtruction and uſe, and he earneſtly ſolicits others to undertake the computation of the intermediate numbers, offering to give inſtructions, and paper ready ruled for that purpoſe, to any perſons inclined to contribute to the completion of ſo valuable a work. By this invitation he had hopes of collecting materials for the logarithms of the intermediate 70000 numbers, while he ſhould employ his time upon the Canon of Logarithmic ſines and tangents, and ſo carry on both works at once.

Soon after this, *Adrian Vlacq* or *Flack* of Gouda in Holland completed the intermediate 70 chiliads, and republiſhed the *Arithmetica Logarithmica* in 1627 and 1628, with theſe intermediate numbers, making in all, the logarithms of all numbers to 100,000, but only to 10 places of figures. To theſe was added a table of artificial ſines, tangents, and ſecants, to every minute of the quadrant.

Briggs himſelf lived alſo to complete a table of logarithmic ſines and tangents, to the 100th part of every degree, to fourteen places of figures beſides the index, together with a table of natural ſines to the ſame parts to fifteen places, and the tangents and ſecants of the ſame to ten places, with the conſtruction of the whole. But his death, which then happened, prevented him from completing the application and uſes of them. However, when dying, he committed the performing of this office to his friend *Henry Gellibrand*, who accordingly added a preface, and the application of the logarithms to plane and ſpherical trigonometry. The work was called *Trigonometria Britannica*, and was printed at Gouda in the year 1633 under the care of *Adrian Vlack*.

In the ſame year, 1633, *Adrian Vlack* printed a work of his own, called *Trigonometria Artificialis, ſive Magnus Canon Triangulorum Logarithmicus ad Decadas Secundorum Scrupulorum Conſtructus*. This work contains the logarithmic ſines and tangents to 10 places of figures, with their differences for every 10 ſeconds in the quadrant. It alſo contains Briggs's table of the firſt 20000 logarithms to ten places, beſides the index, with their differences; and to the whole is prefixed a deſcription of the tables and their applications, chiefly extracted from Briggs's *Trigonometria Britannica*, which we have already mentioned.

Gellibrand publiſhed alſo, in 1635, *An Inſtitution Trigonometrical*, containing the logarithms of the firſt 10,000 numbers, with the natural ſines, tangents, and ſecants, and the logarithmic ſines and tangents for degrees and minutes; all to ſeven places of figures beſides the index.

The writers, whoſe works we have hitherto noticed, were for the moſt part computors of logarithms. But the ſyſtem beſt adapted to practice being now well aſcertained, and the labour of conſtructing the table accompliſhed, ſucceeding writers on the ſubject have had little more to do than to give the tables in the moſt convenient form. It is true that, in conſequence of the numerous diſcoveries which were afterwards made in mathematics, particularly in the doctrine of ſeries, great improvements were made in the method of computing logarithms; but theſe, for the moſt part, came too late to be of uſe in the actual conſtruction of the table, although they might be applied with advantage to verify calculations previouſly performed by methods much more laborious.

As it is of importance that ſuch as have occaſion to employ logarithms ſhould know what works are held in eſtimation on account of their extent and accuracy, we ſhall enumerate the following.

1. Sherwin's *Mathematical Tables*, in 8vo. Theſe contain the logarithms of all numbers to 101,000; and the ſines, tangents, ſecants, and verſed ſines, both natural and logarithmic, to every minute of the quadrant. The third edition, printed in 1742, which was reviſed by Gardiner, is eſteemed the moſt correct; but, in the fifth edition, the errors are ſo numerous, that no dependence can be placed upon it when accuracy is required.

2. Gardiner's Tables of Logarithms for all numbers to 101,000, and for the ſines and tangents to every ten ſeconds of the quadrant; alſo for the ſines of the firſt 72 minutes to every ſingle ſecond, &c. This work, which is in 4to, was printed in 1742, and is held in high eſtimation for its accuracy.

3. An edition of the ſame work, with ſome additions, printed in 1770 in Avignon in France. The tables in both editions are to ſeven places of figures.

4. *Tables Portatives de Logarithmes, publiée à Londres, par Gardiner, augmentées et perfectionées dans leur diſpoſition, par M. Callet.*—This work is moſt beautifully printed in a ſmall octavo volume, and contains all the tables in Gardiner's quarto volume; with ſome additions and improvements.

5. Dr Hutton's Mathematical Tables, containing common hyperbolic and logiſtic logarithms, &c.—This work has paſſed through ſeveral editions, under the care of the learned author: it is perhaps the moſt common of any in this country, and is deſervedly held in the higheſt eſtimation, both on account of its accuracy, and the very valuable information it contains reſpecting the hiſtory of logarithms, and other branches of mathematics connected with them.

6. Taylor's Table of Logarithmic Sines and Tangents to every ſecond of the quadrant; to which is prefixed a table of logarithms from 1 to 100,000, &c.—This is a moſt valuable work; but being a very large quarto volume, and alſo very expenſive, it is leſs adapted to general uſe than the preceding, which is an octavo, and may be had at a moderate price.

7. *Tables portatives des logarithmes, contenant les logarithmes des nombres depuis* 1 *juſqu'* à 108,000; *les logarithmes des ſinus et tangentes, de ſeconde en ſeconde pour les cinq premiers degrees, de dix en dix ſecondes pour tous les degrees du quart-de cercle, et ſuivant la*

 nouvelle

Nature of Logarithms, &c.

nouvelle division centesimale de dix-millieme en dix millieme, &c. *par* Callet.—This work, which is in octavo, may be reasonably expected to be very accurate, it being printed in the stereotype manner, by *Didot*.

In addition to these, it is proper that we should notice a stupendous work relating to logarithms, originally suggested by the celebrated *Carnot*, in conjunction with *Prieur de la Côte d'Or*, and *Brunet de Montpelier*, about the beginning of the French revolution. This enterprise was committed, in the year 1794, to the care of *Prony*, a French mathematician of great eminence, who was *not only to compose tables which should leave nothing to be desired with respect to accuracy, but to make them the most extended and most striking monument of calculation which had ever been executed or ever imagined* *. It appears that two manuscript copies of the work were formed, composed of 17 volumes large folio; and containing, besides an introduction, the following tables.

* Nicholf. Journ. vol. v. 4to series, p. 311.

1. The natural sines for each 10,000th part of the quadrant, calculated to twenty-five places of decimals, to be published with twenty-two decimals and five columns of differences.

2. The logarithms of these sines, calculated to fourteen decimals, with five columns of differences.

3. The logarithms of the ratios of the sines to the arcs for the first five thousand 100,000th parts of the quadrant, calculated to fourteen decimal places, with three columns of differences.

4. The logarithms of the tangents corresponding with the logarithms of the sines.

5. The logarithms of the ratios of the tangents to the arcs calculated like those of the third article.

6. Logarithms of numbers from 1 to 100,000, calculated to nineteen places of decimals.

7. The logarithms of numbers from 100,000 to 200,000, calculated to 24 decimals, in order to be published to 12 decimals and three columns of differences.

The printing of this work was begun at the expence of the French government, but was suspended at the fall of the assignats; whether it has been since resumed we cannot positively say, but it certainly is not yet completed.

SECT. I.

OF THE NATURE OF LOGARITHMS AND THEIR CONSTRUCTION.

WE have already shewn that the properties of logarithms are deducible from those of two series, the terms of one of which form a geometrical progression, and those of the other an arithmetical progression; and as this manner of treating the subject is simple, it is perhaps the best adapted of any to such of our readers as have not pursued the study of mathematics to any great extent. We shall now shew how, from the same principles, the logarithm of any proposed number whatever may be found.

The first step to be taken in constructing a system of logarithms is to assume the logarithm of some determinate number, besides that of unity or 1, which must necessarily be 0. From the particular view which *Napier* took of the subject, he was led to assume unity for the logarithm of the number 2.718282, by which it happened that the logarithm of 10 was 2.302585, and this assumption being made, the form of the system became determinate, and the logarithm of every number fixed to one particular value.

Mr Briggs however observed, that it would be better to assume unity for the logarithm of 10, instead of making it the logarithm of 2.718282, as in Napier's system, and hence the logarithms of the terms of the geometrical progression

1, 10, 100, 1000, 10000, &c.

were necessarily fixed to the corresponding terms of this arithmetical progression,

0, 1, 2, 3, 4, &c.

That is, the logarithm of 1 being 0, and that of 10 being 1, the logarithm of 100 is 2, and that of 1000 is 3, and so on.

The logarithms of the terms of the progression, 1, 10, 100, 1000, &c. being thus determined; in order to form the logarithms of the numbers between 1 and 10, and between 10, and 100, and so on, we must conceive a very great number of geometrical means to be interposed between each two adjoining terms of the preceding geometrical series, and as many arithmetical means between the corresponding terms of the arithmetical series; then, like as the terms of the arithmetical series 0, 1, 2, 3, &c. are the logarithms of the corresponding terms of the geometrical series 1, 10, 100, 1000, &c. the interpolated terms of the former will also be the logarithms of the corresponding interpolated terms of the latter. Now as by supposing the number of means interposed between each two terms of the geometrical series to be sufficiently great, some one or other of them may be found which will be very nearly equal to any proposed number; it is evident that to find the logarithm of such a number, we have only to seek for one of the interpolated means which is very nearly equal to it, and to take the logarithm of that mean as a near value of the logarithm required.

As a particular example, let it be required to find the logarithm of the number 5, according to Briggs's system.

First step of the process.—The number 5 is between 1 and 10, the logarithms of which we already know to be 0 and 1: Let a geometrical mean be found between the two former, and an arithmetical mean between the two latter. The geometrical mean will be the square root of the product of the numbers 1 and 10, which is 3.162277; and the arithmetical mean will be half the sum of the logarithms 0 and 1, which is 0.5; therefore the logarithm of 3.162277 is 0.5. But as the mean thus found is not sufficiently near to the proposed number, we must proceed with the operation as follows:

Second step.—The number 5, whose logarithm is sought is between 3.162277, the mean last found, and 10, the logarithms of which we know to be 0.5 and 1; we must now find a geometrical mean between the two former, and an arithmetical mean between the two latter. The one of these is $\sqrt{(3.162277 \times 10)}$, $= 5.623413$, and the other is $\frac{1+0.5}{2} = 0.75$; therefore the logarithm of 5.623413 is 0.75.

Third step.—We have now obtained two numbers, namely

namely 3.162277 and 5.623413, one on each ſide of 5, together with their logarithms 0.5 and .075, we therefore proceed exactly as before, and accordingly we find the geometrical mean, or $\sqrt{(3.162277 \times 5.623413)}$, to be 4.216964, and the arithmetical mean, or $\frac{0.5+0.75}{2}$ to be 0.625; therefore the logarithm of 4.216964 is 0.625.

Fourth ſtep.—We proceed in the ſame manner with the numbers 4.216964, and 5.623413 (one of which is leſs, and the other greater than 5) and their logarithms 0.625 and 0.75, and find a new geometrical mean, viz. 4.869674, and its correſponding arithmetical mean, or logarithm, 0.6875.

We muſt go on in this way till we have found twenty-two geometrical means, and as many correſponding arithmetical means or logarithms. And that we may indicate how theſe are found from each other, let the numbers 1 and 10 be denoted by A and B, and their geometrical means taken in their order by C, D, E, &c. then the reſults of the ſucceſſive operations will be as in the following table.

		Numbers.	Logarithms.
A =		1.000000	0.0000000
B =		10.000000	1.0000000
C =	$\sqrt{AB}$ =	3.162277	0.5000000
D =	$\sqrt{BC}$ =	5.623413	0.7500000
E =	$\sqrt{CD}$ =	4.216964	0.6250000
F =	$\sqrt{DE}$ =	4.869674	0.6875000
G =	$\sqrt{DF}$ =	5.232991	0.7187500
H =	$\sqrt{FG}$ =	5.048065	0.7031250
I =	$\sqrt{FH}$ =	4.958069	0.6953125
K =	$\sqrt{HI}$ =	5.002865	0.6992187
L =	$\sqrt{IK}$ =	4.980416	0.6972656
M =	$\sqrt{KL}$ =	4.991627	0.6982421
N =	$\sqrt{KM}$ =	4.997242	0.6987304
O =	$\sqrt{KN}$ =	5.000052	0.6989745
P =	$\sqrt{NO}$ =	4.998647	0.6988525
Q =	$\sqrt{OP}$ =	4.999350	0.6989135
R =	$\sqrt{OQ}$ =	4.999701	0.6989440
S =	$\sqrt{OR}$ =	4.999876	0.6989592
T =	$\sqrt{OS}$ =	4.999963	0.6989668
V =	$\sqrt{OT}$ =	5.000008	0.6989707
W =	$\sqrt{TV}$ =	4.999984	0.6989687
X =	$\sqrt{WV}$ =	4.999997	0.6989697
Y =	$\sqrt{VX}$ =	5.000003	0.6989702
Z =	$\sqrt{XY}$ =	5.000000	0.6989700

As the laſt of theſe means, viz. Z, agrees with 5, the propoſed number, as far at leaſt as the ſixth place of decimals, we may ſafely conſider them as very nearly equal, therefore their logarithms will alſo be very nearly equal, that is the logarithm of 5 will be 0.6989700 nearly.

In performing the operations indicated in the preceding table it will be neceſſary to find the geometrical means at the beginning to many more figures than are here put down, in order to obtain at laſt a reſult true to 7 decimal places. Thus it appears that the labour of computing logarithms by this method is indeed very great. It is, however, that which was employed by Briggs and Vlacq in the original conſtruction of logarithms; but ſince the period in which they lived, others more eaſy have been found, as we ſhall preſently have occaſion to explain.

The logarithm of any number whatever may be found by a ſeries of calculations ſimilar to that which we have juſt now explained. But in conſtructing the table it would only be neceſſary to have recourſe to this method in calculating the logarithms of prime numbers; for as often as the logarithm of a number which was the product of other numbers, whoſe logarithms were known, was required, it would be immediately obtained by adding together the logarithms of its factors. On the contrary, if the logarithm of the product of two numbers were known, and alſo that of one of its factors, the logarithm of the other factor would be obtained from theſe, by ſimply taking their difference.

Nature of Logarithms, &c.

From this laſt remark it is obvious, that having now found the logarithm of 5, we can immediately find that of 2; for ſince 2 is the quotient of 10 divided by 5, its logarithm will be the difference of the logarithms of 10 and 5; now the logarithm of 10 is 1, and the logarithm of 5 is 0.6989700, therefore the logarithm of 2 is 0.3010300.

Having thus obtained the logarithms of 2 and 5, in addition to thoſe of 10, 100, 1000, &c. we may thence find the logarithms of innumerable other numbers. Thus, becauſe $4=2\times 2$, the logarithm of 4 will be the logarithm of 2 added to itſelf, or will be twice the logarithm of 2. Again, becauſe $5\times 10=50$, the logarithm of 50 will be the ſum of the logarithms of 5 and 10. In this manner it is evident we may find the logarithms of $8=2\times 4$, of $16=2\times 8$, of $25=5\times 5$, and of as many more ſuch numbers as we pleaſe.

Beſides the view we have hitherto taken of the theory of logarithms, there are others under which it has been preſented by different authors. Some of theſe we proceed to explain, beginning with that in which they are defined to be the *meaſures of ratios*; but to ſee the propriety of this definition, it muſt be underſtood what is meant by the meaſure of a ratio.

According to the definition of a compound ratio, as laid down by writers on geometry, if there be any number of magnitudes A, B, C, D, which are continual proportionals, or ſuch that the ratio of A to B is equal to the ratio of B to C, and that again is equal to the ratio of C to D, and ſo on, the ratio of the firſt of theſe magnitudes A to the third C is conſidered as made up of two equal ratios, each equal to the ratio of the firſt A to the ſecond B. And in like manner the ratio of the firſt A to the fourth D is conſidered as made up of three equal ratios, each equal to the ratio of the firſt to the ſecond, and ſo on. (See GEOMETRY Sect. III. Def. 10, 11, and 12.) Thus, to take a particular example in numbers, becauſe the ratio of 81 to 3 may be conſidered as made up of the ratio of 81 to 27, and of 27 to 9, and of 9 to 3, which three ratios are equal among themſelves, (GEOMETRY Sect. III. Def. 4.) the ratio of 81 to 3 will be triple the ratio of 9 to 3; and in like manner the ratio of 27 to 3 will be double the ratio of 9 to 3. Alſo, becauſe the ratios of 1000 to 100, 100 to 10, 10 to 1, are all equal, the ratio of 1000 to 1 will be three times as great as the ratio of 10 to 1; and the ratio of 100 to 1 will be twice as great; and ſo on.

Taking this view of ratios, and conſidering them as a particular ſpecies of quantities, made up of others of the ſame kind, they may evidently be compared with each other, in reſpect of their magnitudes, in the ſame manner as we compare lines or quantities of any kind whatever.

Nature of Logarithms, &c.

whatever. And as when estimating the relative magnitudes of two quantities, two lines for example, if we find that the one contains five such equal parts as the other contains seven, we say the one line has to the other the proportion of 5 to 7; so, in like manner, if two ratios be such, that the one can be resolved into five equal ratios, and the other into seven of the same ratios, we may conclude that the magnitude of the one ratio is to that of the other as the number 5 to the number 7; and a similar conclusion may be drawn, when the ratios to be compared are any multiples whatever of some other ratio.

It is well known that there may be lines and other quantities, which, as they admit of no common measure, are said to be incommensurable to each other; and the same will also happen to ratios: That is, there may be two ratios such that into whatever number of equal ratios the one is divided, the other cannot possibly be exactly equal to a ratio composed of any number of these. We may however conceive the number of equal ratios into which the one is divided to be so great that a certain number of them shall compose a ratio more nearly equal to the other ratio than by any assignable difference. Therefore, like as we can always find numbers which shall have among themselves, either accurately, or as nearly as we please, the same ratios as any number of lines or other magnitudes have to each other, and which therefore may be taken as the measures, or representatives of the lines; so also, corresponding to any system of ratios, there may be always found a series of numbers which will have the same proportions among themselves as the ratios have to each other, and which may in like manner be called the *measures of the ratios*.

Let us now suppose that unity, or 1, is assumed as the common consequent of all ratios whatever; and that the ratio of 10 (or some particular number) to 1 is compounded of a very great number of equal ratios, as for example 1000,000: then, as each of these will be very near to the ratio of equality, (for it will be the ratio of the first term to the second of a series of one million and one continued proportionals, the first of which is 10 and last 1), it will follow, and is easy to conceive, that the ratios of all other numbers to unity will each be very nearly equal to some multiple of that small ratio. And by supposing the number of small equal ratios of which the ratio of 10 to 1 is composed to be sufficiently great, the ratios of all other numbers to unity may be as nearly equal to ratios which are multiples of that small ratio as we please. Let us still suppose, however, for the sake of illustration, that the number of small ratios contained in that of 10 to 1 is 1000,000 then, as it may be proved that the ratio of 2 to 1 will be very nearly the same as a ratio composed of 301030 of these; and that the ratio of 3 to 1 will be nearly equal to a ratio composed of 477121 of them, and that the ratio of 4 to 1 will be nearly equal to a ratio composed of 602060 of them, and so on; these numbers, viz. 1000000, 301030, 477121, and 602060, or any other numbers proportional to them, will be the *measures* of the ratios of 10 to 1, 2 to 1, 3 to 1, and 4 to 1, respectively; and the same quantities will also be what have been called the *logarithms* of the ratios; for the word *logarithm*, if regard be had to its etymology, is λογῶν ἀριθοὶ, or the numbers of small and equal ratios (or *ratiunculæ* as they have been called) contained in the several ratios of quantities one to another.

Nature of Logarithms, &c.

We have for the sake of illustration, assumed 1000000 as the measure of the ratio of 10 to 1, by which it happens, as already observed, that the measures of the ratios of 2 to 1, 3 to 1, &c. are 301030 and 477121 respectively; as, however, these measures are not absolute, but relative quantities, we may assume any other numbers whatever instead of these, provided they have the same proportions to each other as these numbers have among themselves. Accordingly, we may assume 1 as the measure or logarithm of the ratio of 10 to 1; and then the logarithms of the ratios of 2 to 1, 3 to 1, &c. instead of being 301030, 477121, &c. will be .301030 and .477121, &c. respectively, that is, each will be the one-millionth of what it was before.

In *Briggs's* system, the logarithm of the ratio of 10 to 1, or, to speak briefly, the logarithm of 10, is unity; but we are at liberty to assume any number whatever, as that whose logarithm shall be unity. Napier, in consequence of his particular views of the subject, chose the number 2.718282; and hence it happens that the logarithms of the ratios are expressed by different numbers in the two systems.

It yet remains for us to shew the identity of the properties of logarithms, as explained in the two different views we have now given of the subject; and this may be done as follows.

Let A and B denote any two numbers. The ratio of their product to unity, that is, the ratio of $A\times B$ to 1, is compounded of the ratio of $A\times B$ to B, and of B to 1; (see GEOMETRY Part III. Def. 10.) but since $A\times B$, B, A, and 1 are four proportionals, the ratio of $A\times B$ to B is equal to the ratio of A to 1. Therefore the ratio of $A\times B$ to 1 is compounded of the ratio of A to 1 and of B to 1; and consequently the logarithm of the ratio of $A\times B$ to 1 will be equal to the sum of the logarithms of the ratios of A to 1, and of B to 1; or in other words, the logarithm of $A\times B$ will be the sum of the logarithms of A and B.

And because $\log.(A\times B)=\log.A+\log.B$, therefore, $\log.B=\log.(A\times B)-\log.A$. In this equation let $\frac{C}{D}$ be substituted for B, and D for A, then, (because $A\times B=D\times\frac{C}{D}=C$) we have $\log.\frac{C}{D}=\log.C-\log.D$.

We have now given a short sketch of the theory of logarithms as deducible from the doctrine of ratios. It was in this way that the celebrated Kepler treated the subject according to the strictest rules of geometrical reasoning; and in this he has been followed by Mercator, Halley, Cotes, as well as by other mathematicians of later times, as by Mr Baron Maseres, in his "Elements of Plane Trigonometry," a work in which the whole theory of logarithms is treated with all that perspicuity and accuracy which characterize the ingenious author's various writings. The same mode of treating the subject was likewise adopted by that excellent geometrician Dr Robert Simson, as appears by a short tract in Latin, written by him and published in his posthumous works. As, however, the doctrine of ratios is of a very abstract nature, and the mode of reasoning upon which it has been established is of a peculiar and subtle kind, we presume that the greater number of readers

Nature of Logarithms, &c.

readers will think this view of the ſubject leſs ſimple and natural than the following, in which we mean to deduce the theory of logarithms, as well as the manner of computing them, from the properties of the exponents of powers.

If we attend to the common ſcale of notation in arithmetic, we ſhall find that it is ſo contrived as to expreſs all numbers whatever by means of the powers of the number 10, which is the root of the ſcale, and the nine digits which ſerve as coefficients to theſe powers. Thus, if R denote 10, the root of the ſcale, ſo that R^2 will denote 100, and R^3 1000, and ſo on, the number 471509 is otherwiſe expreſſed by $4R^5+7R^4+1R^3+5R^2+0R^1+9R^0$, which is equivalent to $4R^5+7R^4+R^3+5R^2+9$. Again, the mixt number 371.243 is expreſſed by $3R^2+7R^1+R^0+\frac{2}{R}+\frac{4}{R^2}+\frac{3}{R^3}$, or by $3R^2+7R^1+R^0+2R^{-1}+4R^{-2}+3R^{-3}$. As to vulgar fractions, by transforming them to decimals, they may be expreſſed in the ſame manner. Thus $\frac{3}{8}=.375=3R^{-1}+7R^{-2}+5R^{-3}$. Alſo $\frac{2}{3}=.666$, &c. $=6R^{-1}+6R^{-2}+6R^{-3}+$ &c.

Although the number 10 has been fixed upon as the root of the ſcale of notation, any other number may be employed to expreſs all numbers whatever in the ſame manner; and ſome numbers are even preferable to 10. Thus, making 8 the root of a ſcale, and denoting it by R, the number 2735, when expreſſed according to this ſcale, is $5R^3+2R^2+5R^1+7R^0$, or $5R^3+2R^2+5R+7$; and here we may obſerve, that if a number greater than 10 were aſſumed as the root of the ſcale of notation, it would be neceſſary to adopt ſome new numeral characters in addition to thoſe in common uſe, and if a ſmaller number were aſſumed, we might diſpenſe with ſome of thoſe we already have.

But inſtead of expreſſing all numbers by the ſums of certain multiples of the ſucceſſive powers of ſome particular number, we may alſo expreſs them, if not accurately, at leaſt as near as we pleaſe, by a ſingle power, whole or fractional, of any poſitive number whatever, which may be either whole or fractional, but muſt not be unity.

Let us take, for example, 2 as the number, by the powers of which all others are to be expreſſed. Then it may be ſhewn that the numbers 1, 2, 3, &c. are all expreſſible by the powers of 2, as follows.

$1=2^0$ | $6=2^{2.58496}$ nearly
$2=2^1$ | $7=2^{2.8073}$ nearly
$3=2^{1.58496}$, nearly | $8=2^3$
$4=2^2$ | $9=2^{3.1699}$
$5=2^{2.3219}$, nearly | $10=2^{3.3219}$ nearly,

and ſo on. And if inſtead of 2 we take the number 10, then we have

$1=10^0$ | $6=10^{.77815}$
$2=10^{.30103}$ | $7=10^{.84510}$
$3=10^{.47712}$ | $8=10^{.90309}$
$4=10^{.60206}$ | $9=10^{.95424}$
$5=10^{.69897}$ | $10=10^1$.

Hence we may conclude, that if r be put for ſome determinate number, and n for any indefinite poſitive number, whole or fractional, it is always poſſible to find another number N, ſuch, that the number r being raiſed to the power N ſhall either be exactly equal to n, or ſhall be as near to it as we pleaſe; that is, we ſhall have $r^N=n$.

Nature of Logarithms, &c.

When numbers are expreſſed in this way by the powers of ſome given number r; *the exponent of that power of r which is equal to any aſſigned number is called the logarithm of that number*. Therefore, if $r^N=n$, (n being put for any number) then N will be the logarithm of the number n.

The logarithms which are produced by giving to r ſome determinate value conſtitute a *ſyſtem* of logarithms, and the conſtant number r, from which the ſyſtem is formed, is called the *baſe* or *radical* number of the ſyſtem.

The properties of logarithms may be readily deduced from the above definition as follows. Let a and b be put for any two numbers, and A and B for their logarithms; then, r being ſuppoſed to denote the baſe, or radical number of the ſyſtem, we have $a=r^A$ and $b=r^B$: now if we take the product of a and b, we have $ab=r^A\times r^B=r^{A+B}$; but according to the definition, A+B is the logarithm of ab, (for it is the index of that power of r which is equal to ab) therefore, *the ſum of the logarithms of any two numbers a and b is the logarithm of their product ab*. Again, we have $\frac{a}{b}=\frac{r^A}{r^B}=r^{A-B}$, but here A—B is the index of that power of r which is equal to $\frac{a}{b}$; therefore, A—B is the logarithm of $\frac{a}{b}$; hence, *if one number a be divided by another number b, the exceſs of the logarithm of the dividend above that of the diviſor is equal to the logarithm of the quotient* $\frac{a}{b}$.

Let n expreſs any number whatever, then, raiſing both ſides of the equation $a=r^A$ to the nth power, we have $a^n=(r^A)^n=r^{nA}$; but here nA is manifeſtly the logarithm of a^n; therefore, *the logarithm of a^n, any power of a number, is the product of the logarithm of the number by n, the index of the power. And this muſt evidently be true, whether that index be a whole number, or a fraction, either poſitive or negative.*

From theſe properties it is eaſy to ſee in what manner a table that exhibits the logarithms of all numbers within certain limits may be applied to ſimplify calculations: for ſince the ſum of the logarithms of any two numbers is equal to the logarithm of their product; it follows, that as often as we have occaſion to find the product of two or more numbers, we have only to add their logarithms into one ſum, taking them from the table, and to look in the table for the number whoſe logarithm is equal to that ſum, and this number will be the product required. Alſo, becauſe the exceſs of the logarithm of the dividend above that of the diviſor is equal to the logarithm of the quotient; as often as we have occaſion to divide one number by another, we have

only

Nature of Logarithms, &c.

only to ſubtract the logarithm of the diviſor from that of the dividend, and oppoſite to that logarithm in the table, which is the remainder, we ſhall find the quotient.

As the logarithm of any power of a number is the product of the logarithm of the number, and the index of the power; and on the contrary, the logarithm of any root of a number is the quotient found by dividing the logarithm of the number by the index of the root; it follows, that we may find any power or root of a number, by multiplying the logarithm of the number by the index of the power, or dividing it by the index of the root, and taking that number in the table whoſe logarithm is the product or quotient for the power or root required.

If in the equation $a=r^{A}$ (where a is any number, A its logarithm, and r the baſe of the ſyſtem) we ſuppoſe $a=1$, then, in this caſe $r^{A}=1$; but this equation can only be ſatisfied by putting $A=0$. Hence it appears, *that in every ſyſtem of logarithms, the logarithm of unity muſt be* 0. If on the other hand we aſſume $a=r$; then we have the equation $r=r^{A}$, which is immediately ſatisfied by putting $A=1$; therefore, *the logarithm of the baſe, or radical number of every ſyſtem is neceſſarily unity.*

If we ſuppoſe r to be a poſitive number greater than unity, and a a poſitive number greater than unity, then A will be a poſitive number; for if it be negative we would have $a\left(=r^{-A}=\frac{1}{r^{A}}\right)$ a proper fraction, and at the ſame time a number greater than unity by hypotheſis, which is impoſſible. If on the contrary we ſuppoſe a a proper fraction, then A muſt neceſſarily be negative, for if it were poſitive, then r^{A} would be greater than unity, and $a(=r^{A})$ alſo greater than unity, while by hypotheſis it is a fraction leſs than unity, which is impoſſible. *Therefore, in every ſyſtem, the baſe of which is greater than unity, the logarithm af a whole or mixt number is always poſitive, but the logarithm of a proper fraction is always negative.*

Becauſe the logarithm of r is unity, the logarithm of r^{n} will be n; therefore, *the logarithm of any integer power of the radical number r will always be an integer.*

Let r and r' denote baſes of two different ſyſtems; and let A be the logarithm of a number, a, taken according to the firſt of theſe, and A′ its logarithm taken according to the laſt. Then becauſe $a=r^{A}$, and $a=r'^{A'}$, it follows that $r^{A}=r'^{A'}$, and $r=r'^{\frac{A'}{A}}$. Let us now ſuppoſe that r'' is the baſe of a third ſyſtem of logarithms, and R and R′ the logarithms of r and r' taken according to this third ſyſtem; then becauſe

$$r''^{R}=r, \qquad r''^{R'}=r';$$

we have $r''^{RR'}=r^{R'}$, $r''^{RR'}=r'^{R}$;

therefore $r^{R'}=r'^{R}$, and $r=r'^{\frac{R}{R'}}$; but we have already found $r=r'^{\frac{A'}{A}}$, therefore $r'^{\frac{A'}{A}}=r'^{\frac{R}{R'}}$, and conſequently $\frac{A'}{A}=\frac{R}{R'}$, and $A : A'(: : R' : R) : : \frac{1}{R} : \frac{1}{R'}$.

Nature of Logarithms, &c.

Hence it appears, *that the logarithm of a number, taken according to one ſyſtem, has to its logarithm, taken according to any other ſyſtem, a conſtant ratio, which is the ſame as that of the reciprocals of the logarithms of the radical numbers of thoſe ſyſtems, taken according to any ſyſtem whatever.*

Let us next ſuppoſe, that a and b are two numbers, and A and B their logarithms, taken according to the ſame ſyſtem, and r the baſe of the ſyſtem; then becauſe

$$r^{A}=a, \qquad r^{B}=b;$$

we have $r^{AB}=a^{B}$, $r^{AB}=b^{A}$;

therefore $a^{B}=b^{A}$, and $a=b^{\frac{A}{B}}$, now as r is not found in this equation, the value of the fraction $\frac{A}{B}$ depends only on the numbers a and b; therefore, *the logarithms of any two given numbers have the ſame ratio in every ſyſtem whatever.*

Having now explained the properties which belong to the logarithms of any ſyſtem whatever, we proceed to inveſtigate general rules by which the number correſponding to any logarithm, and on the contrary, the logarithm correſponding to any number, may be found the one from the other. And for this end let us denote any number whatever by y, and its logarithm by x, and put r as before for the baſe, or radical number of the ſyſtem; then by the nature of logarithms we have this equation

$$y=r^{x}.$$

Put $r=1+a$, and let the expreſſion $(1+a)^{x}$ be expanded into a ſeries by the binomial theorem; thus we ſhall have $y=$

$$1+xa+\frac{x(x-1)}{1\,.\,2}a^{2}+\frac{x(x-1)(x-2)}{1\,.\,2\,.\,3}a^{3}+\frac{x(x-1)(x-2)(x-3)}{1\,.\,2\,.\,3\,.\,4}a^{4}+\text{\&c.}$$

Let this ſeries, the terms of which are arranged according to the powers of the quantity a, be transformed into another the terms of which ſhall be arranged according to the powers of x; and to effect this we muſt find the actual products of the factors which conſtitute the powers of a, and arrange the terms anew, as follows,

$$\begin{aligned}
1&=1,\\
xa&=+ax,\\
\frac{x(x-1)}{1\,.\,2}a^{2}&=-\frac{a^{2}}{2}x+\frac{a^{2}}{2}x^{2},\\
\frac{x(x-1)(x-2)}{1\,.\,2\,.\,3}a^{3}&=+\frac{a^{3}}{3}x-\frac{a^{3}}{2}x^{2}+\frac{a^{3}}{6}x^{3},\\
\frac{x(x-1)(x-2)(x-3)}{1\,.\,2\,.\,3\,.\,4}&=-\frac{a^{4}}{4}x+\frac{11a^{4}}{24}x^{2}-\frac{a^{4}}{4}x^{3}+\frac{a^{4}}{24}x^{4},\\
\text{\&c.}&\qquad\text{\&c.}
\end{aligned}$$

ſo that adding into one ſum the quantities on each ſide of the ſign $=$, and recollecting that the ſum of theſe on the left-hand ſide is equal to y, we have

Nature of Logarithms, &c.

$$y=r^x=\begin{cases} 1 \\ +\left(a-\dfrac{a^2}{2}+\dfrac{a^3}{3}-\dfrac{a^4}{4}+\&c.\right)x, \\ +\left(\dfrac{a^2}{2}-\dfrac{a^3}{2}+\dfrac{11a^4}{24}-\&c.\right)x^2, \\ +\left(\dfrac{a^3}{6}-\dfrac{a^4}{4}+\&c.\right)x^3, \\ +\left(\dfrac{a^4}{24}-\&c.\right)x^4, \\ +\&c. \end{cases}$$

which equation, by substituting,

$$\begin{array}{l} A \text{ for } a-\dfrac{a^2}{2}+\dfrac{a^3}{3}-\dfrac{a^4}{4}+\&c. \\ A' \text{ for } \dfrac{a^2}{2}-\dfrac{a^3}{2}+\dfrac{11a^4}{4}-\&c. \\ A'' \text{ for } \dfrac{a^3}{6}-\dfrac{a^4}{4}+\&c. \\ A''' \text{ for } \dfrac{a^4}{24}-\&c. \\ \&c. \end{array}$$

may be abbreviated to

$$r^x=1+Ax+A'x^2+A''x^3+A'''x^4+\&c.$$

Next, to determine the law of connexion of the quantities A, A′, A″, A‴, &c. let $x+z$ be substituted in the last equation for x, (here z is put for any indefinite quantity) thus it becomes

$$r^{x+z}=1+A(x+z)+A'(x+z)^2+A''(x+z)^3+\&c.$$

But $r^{x+z}=r^x\times r^z$, and since it has been shewn that

$$r^x=1+Ax+A'x^2+A''x^3+A'''x^4+\&c.$$

for the very same reason

$$r^z=1+Az+A'z^2+A''z^3+A'''z^4+\&c.$$

therefore the series

$$1+A(x+z)+A'(x+z)^2+A''(x+z)^3+A'''(x+z)^4+\&c.$$

is equal to the product of the two series

$$\begin{array}{l} 1+Ax+A'x^2+A''x^3+A'''x^4+\&c. \\ 1+Az+A'z^2+A''z^3+A'''z^4+\&c. \end{array}$$

That is, by actual involution and multiplication

$$\left.\begin{array}{rrrrr} 1+Ax+A'x^2 & +A''x^3 & +A'''x^4 & +\&c. \\ +Az+2A'xz & +3A''x^2z & +4A'''x^3z & +\&c. \\ +A'z^2 & +3A''xz^3 & +6A'''x^2z^2 & +\&c. \\ & +A''z^3 & +4A'''xz^3 & +\&c. \\ & & +A'''z^4 & +\&c. \end{array}\right\}=$$

$$=\begin{cases} 1+Ax+A'x^2+A''x^3+A'''x^4+\&c. \\ +Az+A^2xz+AA'x^2z+AA''x^3z+\&c. \\ +A'z^2+AA'xz^2+A'A'x^2z^2+\&c. \\ +A''z^3+AA''xz^3+\&c. \\ +A'''z^4+\&c. \end{cases}$$

Now as the quantities A, A′, A″, &c. are quite independent of x and z, the two sides of the equation can only be identical upon the supposition that the co-efficients of like terms in each are equal; therefore, setting aside the first line of each side of the equation, because their terms are the same, and also the first term of the second line, for the same reason, let the coefficients of the remaining terms be put equal to one another, thus we have

$$\left.\begin{array}{r} A^2=2A' \\ AA'=3A'' \\ AA''=4A''' \\ \&c. \end{array}\right\} \text{ and hence we have } \begin{cases} A'=\dfrac{A^2}{1\cdot 2} \\ A''=\dfrac{A^3}{1\cdot 2\cdot 3} \\ A'''=\dfrac{A^4}{1\cdot 2\cdot 3\cdot 4} \\ \&c. \end{cases}$$

Here the law of the coefficients A, A′, A‴, &c. is obvious, each being formed from the preceding by multiplying it by A, and dividing by the exponent of the power of A which is thus formed. Let these values of A′, A″, &c. be now substituted in the equation

$$y=r^x=1+Ax+A'x^2+A''x^3+\&c.$$

and it becomes,

$$y=1+Ax+\frac{A^2}{1\cdot 2}x^2+\frac{A^3}{1\cdot 2\cdot 3}x^3+\frac{A^4}{1\cdot 2\cdot 3\cdot 4}x^4+\&c.$$

thus we have obtained a general formula expressing a number in terms of its logarithm and the base of the system, for we must recollect that the quantity A which is equal to

$$a-\frac{a^2}{2}+\frac{a^3}{3}-\frac{a^4}{4}+\frac{a^5}{5}-\&c.$$

is otherwise expressed by

$$r-1-\frac{(r-1)^2}{2}+\frac{(r-1)^3}{3}-\frac{(r-1)^4}{4}+\frac{(r-1)^5}{5}-\&c.$$

where r denotes the base of the system (A).

If in the formula

$$r^x=1+Ax+\frac{A^2}{1\cdot 2}x^2+\frac{A^3}{1\cdot 2\cdot 3}x^3+\frac{A^4}{1\cdot 2\cdot 3\cdot 4}x^4+\&c.$$

we suppose $x=1$, it becomes

$$r=1+A+\frac{A^2}{1\cdot 2}+\frac{A^3}{1\cdot 2\cdot 3}+\frac{A^4}{1\cdot 2\cdot 3\cdot 4}+\&c.$$

an equation which contains r only; but as r has been all along supposed an indeterminate quantity, this equation must be identical, that is, if instead of A, its value, as expressed above in terms of r, were substituted, the whole would vanish.

Again, let us suppose that $\frac{1}{A}$ is substituted instead of x in the general formula, thus it becomes

$$r^{\frac{1}{A}}=1+1+\frac{1}{1\cdot 2}+\frac{1}{1\cdot 2\cdot 3}+\frac{1}{1\cdot 2\cdot 3\cdot 4}+\&c.$$

Thus

(A) For other analytic methods of investigating the same formula, see **Algebra** § 293, and **Fluxions** § 54. and § 70. Ex. 1. also § 200. Prob. 1.

Nature of Logarithms, &c.

Thus the quantity $r^{\frac{1}{A}}$, whatever be the value of r, is evidently equal to a conſtant number, which, as appears from the laſt equation, is equal to the value of r when $A=1$. By adding together a ſufficient number of the terms of the ſeries expreſſing the value of $r^{\frac{1}{A}}$, we find that quantity equal to

$$2.718281828459045\ldots$$

Let this number be denoted by e, and we have $r^{\frac{1}{A}}=e$, and $r=e^{A}$; hence it appears, that if the number e be conſidered as the baſe of a logarithmic ſyſtem, the quantity A, that is

$$r-1-\frac{(r-1)^2}{2}+\frac{(r-1)^3}{3}-\frac{(r-1)^4}{4}+\frac{(r-1)^5}{5}-\&c.$$

is the logarithm of r to the baſe e. But as r is not reſtricted here to any particular value, we may ſubſtitute y inſtead of it, keeping in mind that y denotes any number whatever, and x its logarithm; thus we have x the logarithm of y, expreſſed by the ſeries

$$y-1-\frac{(y-1)^2}{2}+\frac{(y-1)^3}{3}-\frac{(y-1)^4}{4}+\frac{(y-1)^5}{5}-\&c.$$

ſuppoſing that the baſe of the ſyſtem is the number we have expreſſed above by e.

We have now found a general formula for the logarithm of any number, y, taken according to a particular ſyſtem, namely, that which has the number e for its baſe. But it is eaſy from hence to find a formula, which ſhall apply to any ſyſtem whatever. For it has been ſhewn that the logarithms of the ſame number, taken according to two different ſyſtems, are to each other as the reciprocals of the logarithms of the baſes of the ſyſtems, theſe laſt logarithms being taken according to any ſyſtem whatever, that is,

$$\text{log. } y \text{ to baſe } e : \text{log. } y \text{ to baſe } r :: \frac{1}{\text{log. } e} : \frac{1}{\text{log. } r};$$

hence we find

$$\text{log. } y \text{ to baſe } r=\frac{\text{log. } e}{\text{log. } r}\times\text{log. } y \text{ to baſe } e.$$

Let the value we have already found for the logarithm of y to baſe e be ſubſtituted in this equation, and it becomes

$$\text{log. } y=x=\frac{\text{log. } e}{\text{log. } r}\left\{y-1-\frac{(y-1)^2}{2}+\frac{(y-1)^3}{3}-\frac{(y-1)^4}{4}+\&c.\right\}$$

which is a general formula for the logarithm of *any number whatever*, to the baſe r. And it is to be recollected that in the fraction $\frac{\text{log. } e}{\text{log. } r}$, which is a common multiplier to the ſeries, the logarithms are to be taken according to the ſame baſe, which however may be any number whatever (B).

If in the above formula we ſuppoſe $r=e$, the multiplier $\frac{\text{log. } e}{\text{log. } r}$ will be unity, and the formula will become ſimply

$$\text{log. } y=y-1-\frac{(y-1)^2}{2}+\frac{(y-1)^3}{3}-\frac{(y-1)^4}{4}+\&c.$$

as we have already remarked. Now this is the ſyſtem which was adopted by *Lord Napier*; and although the logarithms which were computed according to this ſyſtem, or upon the ſuppoſition that the radical number is 2.7182818 &c. have been called *hyperbolic logarithms* becauſe they happen to be proportional to certain hyperbolic ſpaces, yet, as the logarithms of every ſyſtem have the ſame property, it is more proper to call them *Napierean logarithms*.

As the conſtant multiplier $\frac{\text{log. } e}{\text{log. } r}$, which occurs in the general formula for the logarithm of any number, is the only part of the formula which depends for its value upon the baſe of the ſyſtem, it has been called by writers on logarithms, the *modulus* of the ſyſtem. If we ſuppoſe the logarithms taken to the baſe e, then the numerator, viz. log. e, will be unity, and the denominator will be the Napierean logarithm of r. If however we ſuppoſe the logarithms taken to the baſe r, then the numerator will be log. e to baſe r; and the denominator will be unity, ſo that the *modulus* of any ſyſtem whoſe baſe is r, is *the reciprocal of the Napierean logarithm of that baſe*; or it is *the logarithm of the number e* (the baſe of the Napierean ſyſtem) *to the baſe r*.

In the Napierian ſyſtem the *modulus* is unity, and hence the logarithms of this ſyſtem, as far as depends upon facility of computation, are the moſt ſimple of any. It was however ſoon found that a ſyſtem whoſe baſe ſhould be the ſame as the root of the ſcale of the arithmetical notation, viz. the number 10, would be the moſt convenient of any in practice; and accordingly ſuch a ſyſtem was actually conſtructed by Mr *Briggs*. This is the only one now in common uſe, and is called *Briggs's ſyſtem*, alſo *the common ſyſtem* of logarithms. The *modulus* of this ſyſtem therefore is the reciprocal of the Napierean logarithm of 10; or it is the common logarithm of $e=2.7182818$ &c. the baſe of the Naperean ſyſtem. We ſhall in future denote this *modulus* by M; ſo that the formula expreſſing the common logarithm of any number y will be

$$\text{log. } y=M\left\{1-y-\frac{(1-y)^2}{2}+\frac{(1-y)^3}{3}-\frac{(1-y)^4}{4}+\&c.\right\}$$

If the number y, whoſe logarithm is required be very near to unity, ſo that $1-y$ is a ſmall quantity, then the logarithm may be found from this formula with great eaſe, becauſe the ſeries will converge very rapidly. If, however, $1-y$ be greater than unity, the ſeries, inſtead of converging, will diverge, ſo as to be in its preſent form of no uſe.

It may however be transformed into another, which ſhall converge in every caſe, by ſubſtituting in it $\sqrt[n]{y}$ inſtead of y, and obſerving that log. $(\sqrt[n]{y})=\frac{\text{log. } y}{n}$; it

(B) For other methods of inveſtigating the ſame formula ſee ALGEBRA 284, and FLUXIONS § 70. Ex. 2. alſo § 136.

Nature of Logarithms, &c.

it thus becomes

$$\log. y = nM\left\{ \sqrt[n]{y} - 1 - \tfrac{1}{2}(\sqrt[n]{y}-1)^2 + \tfrac{1}{3}(\sqrt[n]{y}-1)^3 - \&c. \right\}$$

where n may denote any number whatever, positive or negative. But whatever be the number y, we can always take n, such, that $\sqrt[n]{y}$ shall be as nearly equal to 1, as we please, therefore by this last formula, we can always find the logarithm of y to any degree of accuracy whatever.

If we suppose n to be taken negative, then $\sqrt[n]{y} = \frac{1}{\sqrt[n]{y}}$, and the series which expresses log. y becomes, by changing the signs,

$$\log. y = nM\left\{ 1 - \frac{1}{\sqrt[n]{y}} + \tfrac{1}{2}\left(1 - \frac{1}{\sqrt[n]{y}}\right)^2 + \tfrac{1}{3}\left(1 - \frac{1}{\sqrt[n]{y}}\right)^3 + \&c. \right\}$$

where all the terms are positive. Thus we have it in our power to express the value of y, either by a series which shall have its terms all positive, or by one which shall have its terms alternately positive and negative: for it is evident that y being greater than unity, $\sqrt[n]{y}$ will also be greater than unity, and y being less than unity, $\sqrt[n]{y}$ will also be less than unity, but the differences will be so much the smaller as n the exponent of the root is greater; therefore $\sqrt[n]{y}-1$ will be positive in the first case, and negative in the second.

Because $M = \frac{1}{\text{Nap. log. } 10}$, therefore Nap. log. 10 $= \frac{1}{M}$; hence by the two last formulas we have

$$\frac{1}{M} = n\left\{ \sqrt[n]{10} - 1 - \tfrac{1}{2}(\sqrt[n]{10}-1)^2 + \tfrac{1}{3}(\sqrt[n]{10}-1)^3 - \&c. \right\}$$

also

$$\frac{1}{M} = n\left\{ 1 - \frac{1}{\sqrt[n]{10}} + \tfrac{1}{2}\left(1 - \frac{1}{\sqrt[n]{10}}\right)^2 + \tfrac{1}{3}\left(1 - \frac{1}{\sqrt[n]{10}}\right)^3 + \&c. \right\}$$

It is evident that by giving to $\sqrt[n]{y}$ such a value that $\sqrt[n]{y}-1$ is a fraction less than unity, we render both the series for the value of log. y converging; for as $\sqrt[n]{y}-1$ is a fraction less than unity, the expression $1 - \frac{1}{\sqrt[n]{y}}$ will also be less than unity, seeing that it is equal to $\frac{\sqrt[n]{y}-1}{\sqrt[n]{y}}$. Therefore, in the first series, the second and third terms (taken together as one term) constitute a negative quantity, and as the same is also true of the fourth and fifth, and so on; the amount of all the terms after the first is a negative quantity, that is a quantity which is to be subtracted from the first, that we may have the value of log. y. Hence we may infer that

$$\log. y < nM(\sqrt[n]{y}-1).$$

And since, on the contrary, the terms of the second series are all positive, the amount of all the terms after the first is a positive quantity, that is, a quantity which must be added to the first to give the value of log. y; so that we have

$$\log. y > nM\left(1 - \frac{1}{\sqrt[n]{y}}\right).$$

Nature of Logarithms, &c.

Thus we have two limits to the value of the logarithm of y, which, by taking the number n sufficiently great may come as near to each other as we please.

In like manner we find two limits to the value of the reciprocal to the modulus, viz.

$$\frac{1}{M} < n(\sqrt[n]{10}-1), \quad \frac{1}{M} > n\left(1 - \frac{1}{\sqrt[n]{10}}\right).$$

It is evident that the difference between the two limits of log. y, is

$$nM\left\{ (\sqrt[n]{y}-1) - \left(1 - \frac{1}{\sqrt[n]{y}}\right) \right\},$$

therefore if we take either the one or the other of the two preceding expressions for log. y, the error in excess or defect is necessarily less than this quantity.

By these formulas we may depend upon having the logarithm of any number true to m figures, if we give to n such a value that the root $\sqrt[n]{y}$ shall have m cyphers between the decimal point and the first significant figure on the right. So that in general, as the error is the smaller according as n the exponent of the root is greater, we may conclude that it becomes nothing, or may be reckoned as nothing, when n is taken indefinitely great; and this being the case, we may conclude that either of these expressions

$$nM(\sqrt[n]{y}-1), \quad nM\left(1 - \frac{1}{\sqrt[n]{y}}\right)$$

is the accurate value of log. y.

The best manner of applying the preceding formula is to take some power of the number 2 for n; for by doing so, the root $\sqrt[n]{y}$ may be found by a repetition of extractions of the square root only. It was in this way that Briggs calculated the first logarithms; and he remarked, that if in performing the successive extractions of the square root, he at last obtained twice as many decimal places as there were cyphers after the decimal point, the integer before it being unity, then the decimal part of this root was exactly the half of that which went before; so that the decimal parts of the two roots were to each in the same proportion as their logarithms: now this is an evident consequence of the preceding formula.

To give an example of the application of the formula, let it be required to find the numerical value of M, the modulus of the common system of logarithms, which, as it is the reciprocal of the Napierean logarithm of 10 is equal to

$$\frac{1}{n} \times \frac{1}{\sqrt[n]{10}-1} \text{ nearly,}$$

when n is some very great number. Let us suppose $n = 2^{60} = 8^{20}$; then, dividing unity by 8, and this result again by 8, and so on, we shall after 20 divisions have $\frac{1}{n}$, or $\frac{1}{8^{20}}$ equal to

0.00000 00000 00000 00086 73617 37988 40354.

Also, by extracting the square root of 10, and the square root of this result, and so on, after performing 60 extractions we shall find $\sqrt[n]{10}$ equal to

1.00000 00000 00000 00199 71742 08125 50527 03251.

Therefore,

Nature of Logarithms, &c.

Therefore, $\frac{1}{n}\times\frac{1}{\sqrt[n]{10}-1}$, or M, is equal to

$$\frac{86736173798840354}{199717420812550527}=0.4342944819.$$

As a second example, let it be required to find by the same formula the logarithm of the number 3, which is nearly equal to

$$n\,\mathrm{M}\,(\sqrt[n]{3}-1)=\frac{n(\sqrt[n]{3}-1)}{n(\sqrt[n]{10}-1)}=\frac{\sqrt[n]{3}-1}{\sqrt[n]{10}-1},$$

n being as before a very great number. Let us suppose also in this case that $n=2^{60}$; then after 60 extractions of the square root we have $\sqrt[n]{3}$ equal to

1.00000 00000 00000 0095 28942 64074 58932.

Therefore, taking the value of $\sqrt[n]{10}$ as found in last example, we have

$$\log.\ 3=\frac{\sqrt[n]{3}-1}{\sqrt[n]{10}-1}=\frac{95289426407458932}{199717420812550527}$$
$$=.47712\ 11547\ 19662.$$

This method of computing logarithms is evidently attended with great labour, on account of the number of extractions of roots which it requires, to obtain a result true to a moderate number of places of figures. But the two series, which we have given, serve to simplify and complete it. For, whatever be the number y, it is only necessary to proceed with the extractions of the square root, till we have obtained for $\sqrt[n]{y}$ a value which is unity followed by a decimal fraction; and then $\sqrt[n]{y}-1$, being a fraction, its powers will also be fractions, which will be so much the smaller as their exponents are greater; thus a certain number of terms of the series will serve to express the logarithm to as many decimal places as may be required.

There are yet other analytical artifices by which the series

$$\log.y=\mathrm{M}\left\{y-1-\tfrac{1}{2}(y-1)^2+\tfrac{1}{3}(y-1)^3-\tfrac{1}{4}(y-1)^4+\text{\&c.}\right\}$$

may be transformed into others which shall always converge, and in particular the following. Let $1+u$ be substituted in the series for y; then it becomes

$$\log.\,(1+u)=\mathrm{M}\left(u-\frac{u^2}{2}+\frac{u^3}{3}-\frac{u^4}{4}+\frac{u^5}{5}-,\ \text{\&c.}\right).$$

In like manner let $1-u$ be substituted for y, and we have

$$\log.\,(1-u)=\mathrm{M}\left(-u-\frac{u^2}{2}-\frac{u^3}{3}-\frac{u^4}{4}-\frac{u^5}{5}-,\ \text{\&c.}\right).$$

Let each side of the latter equation be subtracted from the corresponding side of the former; the result on the left-hand side will be log. $(1+u)$— log. $(1-u)$, which, by the nature of logarithms, is equal to log. $\frac{1+u}{1-u}$; and on the right-hand side the alternate terms of the two series, having the same sign, these will by subtraction destroy each other, so that we shall have

$$\log.\,\frac{1+u}{1-u}=2\mathrm{M}\left\{u+\frac{u^3}{3}+\frac{u^5}{5}+\frac{u^7}{7}+,\ \text{\&c.}\right\}$$

which series, by substituting z for $\frac{1+u}{1-u}$, and consequently $\frac{z-1}{z+1}$ for u, will be otherwise expressed thus,

Nature of Logarithms, &c.

$$\log.z=2\mathrm{M}\left\{\frac{z-1}{z+1}+\tfrac{1}{3}\left(\frac{z-1}{z+1}\right)^3+\tfrac{1}{5}\left(\frac{z-1}{z+1}\right)^5+\text{\&c.}\right\};$$

and this formula for the logarithm of a number is not only simple, but has also the property of converging in every possible case.

That we may give an example of the utility of this formula we shall employ it in the calculation of the Napierean logarithm of 2, which by the above formula will be

$$2\left(\frac{1}{3}+\frac{1}{3\cdot3^3}+\frac{1}{5\cdot3^5}+\frac{1}{7\cdot3^7}+\frac{1}{9\cdot3^9}+\text{\&c.}\right)$$
$$=\mathrm{A}+\tfrac{1}{3}\mathrm{B}+\tfrac{1}{5}\mathrm{C}+\tfrac{1}{7}\mathrm{D}+\tfrac{1}{9}\mathrm{E}+\text{\&c.}$$

where A is put for $\frac{2}{3}$, B for $\frac{2}{3^3}=\frac{\mathrm{A}}{9}$, C for $\frac{2}{3^5}=\frac{\mathrm{B}}{9}$, D for $\frac{2}{3^7}=\frac{\mathrm{C}}{9}$, &c. The calculation will be as follows.

$\mathrm{A}=\ .666666666666$
$\mathrm{B}=\frac{1}{9}\mathrm{A}=.074074074074$
$\mathrm{C}=\frac{1}{9}\mathrm{B}=.008230452674$
$\mathrm{D}=\frac{1}{9}\mathrm{C}=.000914494742$
$\mathrm{E}=\frac{1}{9}\mathrm{D}=.000101610527$
$\mathrm{F}=\frac{1}{9}\mathrm{E}=.000011290059$
$\mathrm{G}=\frac{1}{9}\mathrm{F}=.000001254451$
$\mathrm{H}=\frac{1}{9}\mathrm{G}=.000000139383$
$\mathrm{I}=\frac{1}{9}\mathrm{H}=.000000015487$
$\mathrm{K}=\frac{1}{9}\mathrm{I}=.000000001721$
$\mathrm{L}=\frac{1}{9}\mathrm{K}=.000000000191$
$\mathrm{M}=\frac{1}{9}\mathrm{L}=.000000000021$

$\mathrm{A}=.666666666666$
$\frac{1}{3}\mathrm{B}=.024691358025$
$\frac{1}{5}\mathrm{C}=.001646090535$
$\frac{1}{7}\mathrm{D}=.000130642106$
$\frac{1}{9}\mathrm{E}=.000011290059$
$\frac{1}{11}\mathrm{F}=.000001026369$
$\frac{1}{13}\mathrm{G}=.000000096496$
$\frac{1}{15}\mathrm{H}=.000000009292$
$\frac{1}{17}\mathrm{K}=.000000000911$
$\frac{1}{19}\mathrm{L}=.000000000091$
$\frac{1}{21}\mathrm{M}=.000000000001$

Nap. log. 2 $=.693147180551$

Thus, by a very easy calculation, we have obtained the Napierean logarithm of 2 true to the first ten places of figures; the accurate value, as far as the 12th place, being 0.693147180550.

If this very simple process by which we have found the logarithm of 2 (the whole of which is here actually put down), be compared with the laborious calculations which must have been performed to have found the same logarithm by the method explained in the beginning of this section, the great superiority of this method to the other, and even to the second method, by which we have found the numerical value of M, and the common logarithm of 3, must be very apparent.

In the same manner as we have found the logarithm of 2 we may find those of 3, 5, &c. In computing the logarithm

Nature of Logarithms, &c.

logarithm of 3 the ſeries would converge by the powers of the fraction $\frac{3-1}{3+1}=\frac{1}{2}$, and in computing the logarithm of 5 it would converge by the powers of $\frac{5-1}{5+1}=\frac{2}{3}$; but in each of theſe caſes the ſeries would converge ſlower, and of courſe the labour would be greater than in computing the logarithm of 2. And if the number whoſe logarithm was required was ſtill more conſiderable; as for example 199, the ſeries would converge ſo ſlow as to be uſeleſs.

We may however avoid this inconvenience by again transforming this laſt formula into another which ſhall expreſs the logarithm of any number by means of a ſeries, and a logarithm ſuppoſed to be previouſly known. To effect this new transformation, let $\frac{1+u}{1-u}=1+\frac{z}{n}$, then, by reſolving this equation in reſpect of u, we have $u=\frac{z}{2n+z}$. Let theſe values of $\frac{1+u}{1-u}$ and u be ſubſtituted in the formula,

$$\log.\frac{1+u}{1-u}=2M\left(u+\frac{u^3}{3}+\frac{u^5}{5}+\frac{u^7}{7}+\&c.\right)$$

and we have $\log.\left(1+\frac{z}{n}\right)$ equal to

$$2M\left\{\frac{z}{2n+z}+\tfrac{1}{3}\left(\frac{z}{2n+z}\right)^3+\tfrac{1}{5}\left(\frac{z}{2n+z}\right)^5+\&c.\right\}$$

but $\log.\left(1+\frac{z}{n}\right)=\log.\frac{n+z}{n}=\log.(n+z)-\log.n$, therefore, by ſubſtituting this value of $\log.\frac{n+z}{n}$, and tranſpoſing $\log.n$ to the other ſide of the equation, we have

$$\log.(n+z)=\log.n+$$
$$2M\left\{\frac{z}{2n+z}+\tfrac{1}{3}\left(\frac{z}{2n+z}\right)^3+\tfrac{1}{5}\left(\frac{z}{2n+z}\right)^5+\&c.\right\}$$

By the aſſiſtance of this formula, and the known properties of logarithms, we may proceed calculating the logarithm of one number from that of another as follows.

To find the Napierean logarithm of 3 from that of 2, which has been already found. We have here $n=2$, $z=1$, and $\frac{z}{2n+z}=\frac{1}{5}$. Therefore the logarithm required is equal to

$$\log.2+2\left(\frac{1}{5}+\frac{1}{3.5^3}+\frac{1}{5.5^5}+\frac{1}{7.5^7}+\&c.\right)$$
$$=\log.2+A+\tfrac{1}{3}B+\tfrac{1}{5}C+\tfrac{1}{7}D+\tfrac{1}{9}E+\&c.$$

where A is put for $\frac{2}{5}$, B for $\frac{A}{25}$, C for $\frac{B}{25}$, and ſo on.

The calculation may ſtand thus:

$A = .400000000000$
$B=\frac{1}{25}A=.016000000000$
$C=\frac{1}{25}B=.000640000000$
$D=\frac{1}{25}C=.000025600000$
$E=\frac{1}{25}D=.000001024000$
$F=\frac{1}{25}E=.000000040960$
$G=\frac{1}{25}F=.000000001638$
$H=\frac{1}{25}G=.000000000066$

$A=.400000000000$
$\frac{1}{3}B=.005333333333$
$\frac{1}{5}C=.000128000000$
$\frac{1}{7}D=.000003657143$
$\frac{1}{9}E=.000000113778$
$\frac{1}{11}F=.000000003724$
$\frac{1}{13}G=.000000000125$
$\frac{1}{15}H=.000000000004$

.405465108108
Nap. log. 2. = .693147180551

Nap. log. 3. = 1.098612288659

This logarithm is true to 10 decimal places, the accurate value to 12 figures being 1.098612288668.

To find the Napierean logarithm of 4. This is immediately had from that of 2 by conſidering that as $4=2^2$, therefore log. 4 = log. 2 + log. 2.

Nap. log. 2 = .693147180551
2

Nap. log. 4 = 1.386294361102

This logarithm is alſo true to 10 places beſides the integer.

To find the Napierean logarithm of 5, from that of 4; we have $n=4$, $z=1$ & $\frac{z}{2n+1}=\frac{1}{9}$, therefore the logarithm of 5 is expreſſed by

$$\log.4+2\left(\frac{1}{9}+\frac{1}{3.9^3}+\frac{1}{5.9^5}+\frac{1}{7.9^7}+\&c.\right)$$
$$\log.4+A+\tfrac{1}{3}B+\tfrac{1}{5}C+\tfrac{1}{7}D+\&c.$$

where $A=\frac{2}{9}$, $B=\frac{1}{81}A$, $C=\frac{1}{81}B$, &c.

The calculation.

$A=.222222222222$
$B=\frac{1}{81}A=.002743484225$
$C=\frac{1}{81}B=.000033870176$
$D=\frac{1}{81}C=.000000418150$
$E=\frac{1}{81}D=.000000005162$
$F=\frac{1}{81}E=.000000000064$

$A=.222222222222$
$\frac{1}{3}B=.000914494742$
$\frac{1}{5}C=.000006774035$
$\frac{1}{7}D=.000000059736$
$\frac{1}{9}E=.000000000574$
$\frac{1}{11}F=.000000000006$

.223143551315
Nap. log. 4 = 1.386294361102

Nap. log. 5 = 1.609437912417

This reſult is alſo correct to the firſt ten places of decimals.

The

Nature of Logarithms, &c.

The logarithm of 6 is found from those of 2 and 3 by considering, that because $6=2\times 3$, therefore log. 6 $=$ log. 2 $+$ log. 3.

$$\begin{array}{l} \text{Nap. log. } 2=0.693147180551 \\ \text{Nap. log. } 3=1.098612288659 \\ \hline \text{Nap. log. } 6=1.791759469210 \end{array}$$

This result is correct as far as the tenth decimal place.

We might find the logarithm of 7 from the logarithm of 6, that is, from the logarithms of 3 and 2, in the same manner as we have found the logarithms of 5 and 3; but it may be more readily found from the logarithms of 2 and 5 by reasoning thus. Because $\frac{2\times 5^2}{7^2}=\frac{50}{49}$, therefore log. $2+2$ log. $5-2$ log. 7 $=\text{log.}\frac{50}{49}$, and consequently

$$\text{log. } 7=\tfrac{1}{2}\text{ log. } 2+\text{ log. } 5-\tfrac{1}{2}\text{ log. }\frac{50}{49}$$

Now the logarithm of $\frac{50}{49}$ may be readily obtained from the formula

$$\text{log. } z=2\text{M}\left\{\frac{z-1}{z+1}+\tfrac{1}{3}\left(\frac{z-1}{z+1}\right)^3+\tfrac{1}{5}\left(\frac{z-1}{z+1}\right)^5+\&\text{c.}\right\}$$

For substituting $\frac{50}{49}$ for z, the formula gives

$$\text{Nap. log. }\frac{50}{49}=2\left(\frac{1}{99}+\frac{1}{3\cdot 99^3}+\frac{1}{5\cdot 99^5}+\&\text{c.}\right)$$
$$=\text{A}+\tfrac{1}{3}\text{B}+\tfrac{1}{5}\text{C}+\&\text{c.}$$

where $\text{A}=\frac{2}{9.11}$, $\text{B}=\frac{\text{A}}{9^2.11^2}$, $\text{C}=\frac{\text{B}}{9^2.11^2}$, &c. This series converges with great rapidity, and a few of its terms will be sufficient to give the logarithm of 7, as appears from the following operation,

$$\text{A}=.020202020202$$
$$\text{B}=\frac{1}{9^2.11^2}\text{A}=.000002061220$$
$$\text{C}=\frac{1}{9^2.11^2}\text{B}=.000000000210$$

$$\begin{array}{r} \text{A}=.020202020202 \\ \tfrac{1}{3}\text{B}=.000000687073 \\ \tfrac{1}{5}\text{C}=.000000000042 \\ \hline \text{Nap. log. }\frac{50}{49}=.020202707317 \end{array}$$

$$\begin{array}{r} \tfrac{1}{2}\text{ log. } 2=0.346573590275 \\ \text{log. } 5=1.609437912417 \\ \hline 1.956011502692 \\ \tfrac{1}{2}\text{ log. }\frac{50}{49}=0.010101353658 \\ \hline \text{Nap. log. } 7=1.945910149034 \end{array}$$

This logarithm, like those we found before, is correct in the first ten decimal places.

Nature of Logarithms, &c.

The logarithms of 8, 9, and 10 are immediately obtained from those of 2, 3, and 5, as follows:

$$\begin{array}{r} \text{Nap. log. } 2=0.693147180551 \\ 3 \\ \hline \text{Nap. log. } 8=2.079441541653 \end{array}$$

$$\begin{array}{r} \text{Nap. log. } 3=1.098612288659 \\ 2 \\ \hline \text{Nap. log. } 9=2.197224577318 \end{array}$$

$$\begin{array}{r} \text{Nap. log. } 2=0.693147180551 \\ \text{Nap. log. } 5=1.609437912417 \\ \hline \text{Nap. log. } 10=2.302585092968 \end{array}$$

Thus by a few calculations we have found the Napierean logarithms of the first ten numbers, each true to ten decimal places; and since the Napierean logarithm of 10 is now known, the *modulus* of the common system, which is the reciprocal of that logarithm will also be known, and will be

$$\frac{1}{2.302585092968}=.4342944819$$

The common logarithms of the first ten numbers may now be found from the Napierean logarithms by multiplying each of the latter by the *modulus*, or dividing by its reciprocal, that is, by the Napierean logarithm of 10. And as the *modulus* of the common system is so important an element in the theory of logarithms, we shall give its value, together with that of its reciprocal, as far as the 30th decimal place.

$$\text{M}=.434294481903251827651128918917$$
$$\frac{1}{\text{M}}=2.302585092994045684017991454684$$

The formulas we have already given are sufficient for finding the logarithms of all numbers whatever throughout the table, but there are yet others which may often be applied with great advantage, and we shall now investigate some of these.

Because

$$\text{log. } z=2\text{M}\left\{\frac{z-1}{z+1}+\tfrac{1}{3}\left(\frac{z-1}{z+1}\right)^3+\tfrac{1}{5}\left(\frac{z-1}{z+1}\right)^5\&\text{c.}\right\}$$

If we now suppose

$$z=\frac{n^2}{n^2-1}=\frac{n^2}{(n-1)(n+1)}$$

so that $\frac{z-1}{z+1}=\frac{1}{2n^2-1}$, then the formula becomes

$$\text{log. }\frac{n^2}{(n-1)(n+1)}=2\text{M}\left\{\frac{1}{2n^2-1}+\right.$$
$$\left.\tfrac{1}{3}\left(\frac{1}{2n^2-1}\right)^3+\tfrac{1}{5}\left(\frac{1}{(2n^2-1)}\right)^5+\&\text{c.}\right\}$$

But

Nature of Logarithms, &c.

But log. $\frac{n^2}{(n-1)(n\times 1)}=2$ log. n — log. $(n-1)$ — log. $(n+1)$, therefore, putting N for the series

$$2M\left\{\frac{1}{2n^2-1}+\tfrac{1}{3}\left(\frac{1}{2n^2-1}\right)^3+\tfrac{1}{5}\left(\frac{1}{2n^2-1}\right)^5+\&c.\right\}$$

we have this formula,

$$2\log. n-\log. (n-1)-\log. (n+1)=N$$

and hence, as often as we have the logarithms of any two of three numbers whose common difference is unity, the logarithm of the remaining number may be found. Example. Having given

the common log. of $9=0.95424250943$
the common log. of $10=1$;

it is required to find the common logarithm of 11.

Here we have $n=10$, so that the formula gives in this case 2 log. 10—log. 9—log. 11=N, and hence we have

$$\log. 11=2\log. 10-\log. 9-N,$$

$$\text{where } N=\frac{2M}{199}+\frac{2M}{3\cdot 199^3}+\&c.$$

M being .43429448190.

Calculation of N.

$$A=\frac{2M}{199}=.00436476866$$
$$B=\frac{A}{3\cdot 199^2}=.00000003674$$
$$.00436480540$$

$$2\log. 10=2.00000000000$$
$$\log. 9=0.95424250943$$
$$N=0.00436480540$$
$$\log. 9+N=0.95860731483$$
$$\log. 11=1.04139268517$$

Here the series expressed by N converges very fast, so that two of its terms are sufficient to give the logarithm true to 10 places of decimals. But the logarithm of 11 may be expressed by the logarithms of smaller numbers and a series which converges still more rapidly, by the following artifice, which will apply also to some other numbers. Because the numbers 98, 99, and 100 are the products of numbers, the greatest of which is 11, for $98=2\times 7^2$, $99=9\times 11$, and $100=10\times 10$, it follows that if we have an equation composed of terms which are the logarithms of these three numbers, it may be resolved into another, the terms of which shall be the logarithms of the number 11 and other smaller numbers. Now by the preceding formula, if we put 99 for n, we have

$$2\log. 99-\log. 98-\log. 100=N.$$

that is, substituting log. 9+log. 11 for log. 99, log. 2+2 log. 7 for log. 98, and 2 log. 10 for log. 100,

$$2\log. 9+2\log. 11-\log. 2-2\log. 7-2\log. 10=N,$$

and hence by transposition, &c.

Nature of Logarithms, &c.

$$\log. 11=\tfrac{1}{2}N+\tfrac{1}{2}\log. 2+\log. 7-\log. 9+\log. 10;$$

and in this equation.

$$N=\frac{2M}{19601}+\tfrac{1}{3}\frac{2M}{19601^3}+\&c.$$

The first term alone of this series is sufficient to give the logarithm of 11 true to 14 places.

Another formula, by which the logarithm of a number is expressed by the logarithms of other numbers and a series, may be found as follows.

Resuming the formula

$$\log. z=2M\left\{\frac{z-1}{z+1}+\tfrac{1}{3}\left(\frac{z-1}{z+1}\right)^3+\tfrac{1}{5}\left(\frac{z-1}{z+1}\right)^5+\&c.\right\}$$

Let us assume

$$z=\frac{(n-1)^2(n+2)}{(n-2)(n+1)^2}=\frac{n^3-3n+2}{n^3-3n-2}$$

$$\text{then } \frac{z-1}{z+1}=\frac{2}{n^3-3n}$$

Let these values of z, & $\frac{z-1}{z+1}$ be substituted in the formula, and it becomes

$$\log.\frac{(n-1)^2(n+2)}{(n-2)(n+1)^2}=2M\left\{\frac{2}{n^3-3n}+\tfrac{1}{3}\left(\frac{3}{n^3-3n}\right)^3+\&c.\right\}$$

But the quantity on the left-hand side of this equation is manifestly equal to 2 log, $(n-1)$+log. $(n+2)$ — log. $(n-2)$ — 2 log. $(n+1)$, therefore, putting P for the series.

$$2M\left\{\frac{2}{n^3-3n}+\tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3+\tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5+\&c.\right\}$$

we have this formula.

$$\log. (n+2)+2\log. (n-1)-\log.(n-2)-2\log.(n+1)=P$$

By this formula we may find, with great facility, the logarithm of any one of the four numbers $n-2$, $n-1$, $n+1$, $n+2$, having the logarithms of the other three. We may also employ it in the calculation of logarithms, as in the following example. Let the numbers 5, 6, 7, 8, be substituted successively in the formula; then, observing that log. 6=log. 2+log. 3, and log. 8=3 log. 2, we have these four equations.

$$\log. 7+2\log. 2-3\log. 3=\frac{2M}{55}+\frac{2M}{3\cdot 55^3}+\&c.$$

$$-2\log. 7+\log. 2+2\log. 5=\frac{2M}{99}+\frac{2M}{3\cdot 99^3}+\&c.$$

$$4\log. 3-4\log. 2-\log. 5=\frac{2M}{161}+\frac{2M}{3\cdot 161^3}+\&c.$$

$$\log. 5-5\log. 3+2\log. 7=\frac{2M}{244}+\frac{2M}{3\cdot 244^3}+\&c.$$

Let log. 2, log. 3, log. 5 and log. 7 be now considered as four unknown quantities, and by resolving these equations in the usual manner, (see ALGEBRA, Sect. VII.) the logarithms may be determined.

Resuming once more the formula

$$\log. z=2M\left\{\frac{z-1}{z+1}+\tfrac{1}{3}\left(\frac{z-1}{z+1}\right)^3+\&c.\right\},$$

let

Nature of Logarithms, &c.

let $\frac{n^2(n+5)(n-5)}{(n+3)(n-3)(n+4)(n-4)}$ be substituted in it instead of z, then, by this substitution $\frac{z-1}{z+1}$ will become $\frac{-72}{n^4-25n^2+72}$ the formula will be transformed to

$$\log.\frac{n^2(n+5)(n-5)}{(n+3)(n-3)(n+4)(n-4)}$$
$$=-2M\left\{\frac{72}{n^4-25n^2+72}+\tfrac{1}{3}\left(\frac{72}{n^4-25n^2+72}\right)^3+\&c.\right\}$$

Hence, putting the latter side of this equation equal to Q, we have this formula,

$$\left.\begin{array}{l}2\log.n+\log.(n+5)+\log.(n-5)-\log.(n+3)\\ -\log.(n-3)-\log.(n+4)-\log.(n-4)+Q\end{array}\right\}=0$$

which may be applied to the calculation of logarithms in the same manner as the former.

When it is required to find the logarithm of a high number, as for example 1231, we may proceed as follows:

$$\log.1231=\log.(1230+1)=\log.\left\{1230\left(1+\frac{1}{1230}\right)\right\}$$
$$=\log.\ 1230+\log.\left(1+\frac{1}{1230}\right)$$

Again, $\log.\ 1230=\log.\ 2+\log.\ 5+\log.\ 123$ and $\log.$

$$123=\log.\left\{120\left(1+\frac{1}{40}\right)\right\}$$
$$=\log.\ 120+\log.\left(1+\frac{1}{40}\right)$$

$\log.\ 120=\log.\ (2^3\times3\times5)=3\log.\ 2+\log.3+\log.5$

Therefore

$$\log.\ 1231=4\log.\ 2+\log.\ 3+2\log.\ 5+\log.\left(1+\frac{1}{40}\right)$$
$$+\log.\left(1+\frac{1}{1230}\right)$$

Thus the logarithm of the proposed number is expressed by the logarithms of 2, 3, 5, and the logarithms of $1+\frac{1}{40}$, $1+\frac{1}{1230}$, all of which may be easily found by the formulas already delivered.

Having now explained, at considerable length, the theory of logarithms upon principles purely analytical, such being, as we conceive, the most natural way of reasoning concerning the properties of number, we shall conclude this section by stating briefly the ground upon which it was referred to the principles of geometry by the mathematicians of the 17th century. Let C be the centre, and CH, CK the asymptotes of an hyperbola. In either of these let there be taken any number of continual proportionals CA, CB, CD, CE, &c. then if B*b*, D*d*, E*e*, &c. be drawn parallel to the other asymptote, meeting the curve in *a*, *b*, *d*, *e*, &c. the hyperbolic spaces A*ab*B, B*bd*D, D*de*E, &c. are equal to one another; also if straight lines be drawn from C to the points *a*, *b*, *d*, *e*, &c. the hyperbolic sectors *a*C*b*, *b*C*d*, *d*C*e*, &c. shall also be equal (Conic Sections Part III. prop. 30.) Now, since it

2

appears by this proposition that the segments CA, CB, CD, CE, &c. of the asymptote being taken in continued geometrical progression, the corresponding hyperbolic areas A*ab*B, A*ad*D, A*ae*E, &c. constitute a series of quantities in continued arithmetical progression, it is evident that the two series will have, in respect to each other, the same properties as numbers and their logarithms; so that, if we assume CA any segment of the asymptote as the representative of unity, and suppose CB, CD, CE, &c. to be the representatives of other numbers, the hyperbolic areas A*ab*B, A*ad*D, A*ae*E will be the geometrical representatives of the logarithms of these numbers; and so also will the hyperbolic sectors C*ab*, C*bd*, C*de*, &c.

Let CA (the line denoting unity) be the side of a rhombus CA*a*L inscribed at the vertex of the hyperbola, and let CP=$n\times$CA (n being put for any number); draw P*p* parallel to CL meeting the hyperbola in *p*, then it may be shewn, by the methods usually employed in reasoning about curvilineal areas, that the area of the rhombus A*a*LC is to the hyperbolic area A*ap*P as 1 to the Napierean logarithm of the number *n*. Therefore if the hyperbola be equilateral, so that A*a*L*c* is a square, &c. consequently its area$=1\times1=1$, the Napierean logarithm of *n*, and the area A*ap*P may be taken as the mutual representatives of each other. It is this circumstance which induced mathematicians to call these logarithms *hyperbolic*. But with equal propriety might the logarithms of any other system be called hyperbolic, as they may be equally expressed by the area of the equilateral hyperbola, or indeed by the area of any hyperbola whatever, (see Fluxions § 152. Ex. 5.)

SECT. II.

DESCRIPTION AND USE OF THE TABLE.

Description and Use of the Table.

THE common system of logarithms is so constructed, that, 0 being the logarithm of unity, or 1, the logarithm of 10 is 1; by which it happens that the logarithm of 100 is 2, that of 1000 is 3, and so on. Also, the logarithm of $\frac{1}{10}$, or .1, is -1, that is, 1 considered as subtractive; or, in the language of algebra, *minus* one; and the logarithm of $\frac{1}{100}$ or .01, is -2; and the logarithm of .001 is -3, and so on, as in the following short table.

Numbers.	Logarithms.
....	..
.001	—3
.00	—2
.1	—1
1	0
10	1
100	2
1000	3
&c.	&c.

As the terms of the geometrical progression 1, 10, 100, &c. continued backwards as well as forward, are the only numbers whose logarithms are integers; the logarithms of all other numbers whatever must be either fractions, or mixt numbers. Accordingly, the logarithms of all numbers, whether integer or mixt, between 1 and 10 are expressed by decimal fractions less than

than unity. The logarithms of numbers between 10 and 100 are expreſſed by mixt numbers compoſed of unity and a decimal fraction. The logarithms of numbers between 100 and 1000 are expreſſed by mixt numbers compoſed of the number 2 and a decimal fraction, and ſo on. On the other hand, the logarithm of any vulgar or decimal fraction leſs than 1, but greater than $\frac{1}{10}$ or .1, will be ſome negative decimal fraction between 0 and —1; and the logarithm of any fraction between .1 and .01, will be a negative mixed quantity between —1 and —2, and ſo on.

But it muſt be remarked, that any fraction, or mixt number, conſidered as entirely negative, may always be transformed into another mixt number of equal value, that ſhall have its integer part negative, but its fractional part poſitive, by diminiſhing the integer by unity, and increaſing the fractional part by the ſame quantity. Thus let the mixt quantity be $-2\frac{3}{10}$, which may be alſo written thus $-2-\frac{3}{10}$. Let the integer —2 be diminiſhed by 1, and the reſult is $-2-1=-3$. Alſo, let the fraction $-\frac{3}{10}$ be increaſed by 1, and it becomes $-\frac{3}{10}+1=+\frac{7}{10}$; therefore the fraction $-2\frac{3}{10}$ or -2.3, when transformed, is $-3+\frac{7}{10}$, or $-3+.7$, which may be written thus, $\bar{3}.7$; where the negative ſign is placed over the integer to indicate that it is the only part of the expreſſion that is conſidered as negative, the other part, viz. .7, being reckoned poſitive.

Since therefore any fractional or mixt quantity, conſidered as entirely negative, is equivalent to another mixt quantity, the integer part of which only is negative, but the fractional part poſitive, it is evident that inſtead of expreſſing the logarithms of fractions by numbers conſidered as entirely negative, we may expreſs them by numbers having their integer parts negative, and their decimal parts poſitive; and it is uſual ſo to expreſs them. Thus the logarithm of .03, inſtead of being expreſſed by —1.52288, that is, by —1—.52288, is uſually expreſſed by $\bar{2}.47712$, by which is to be underſtood $-2+.47712$. Again, the logarithm of .7, which, if conſidered as entirely negative, would be —.15490, is otherwiſe $\bar{1}.84510$.

As the logarithms of any ſeries of numbers forming a geometrical progreſſion, the common ratio of which is 10, will exceed each other by the logarithm of 10, that is, by 1, it follows that the logarithms of all numbers denoted by the ſame figures, and differing only in the poſition of the decimal point, will have the decimal part of their logarithms the ſame; but the integers ſtanding before the decimals will be different, and will be poſitive or negative, according as the numbers are whole or fractional, as in theſe examples.

Numbers.	Logarithms.
69150	4.83980
6915	3.83980
691.5	2.83980
69.15	1.83980
6.915	0.83980
.6915	$\bar{1}$.83980
.06915	$\bar{2}$.83980

The integer figure of a logarithm, is called its *index* or *characteriſtic*; and *it is always leſs by one than the number of integer figures which the natural number conſiſts of; or it is equal to the diſtance of the firſt figure from the place of units or firſt place of integers, whether on the left or on the right of it.*

The table of logarithms given at the end of this article, contains the decimal parts of the logarithms of all numbers from 1 to 10,000; and indeed of all numbers which can be expreſſed by four figures, preceded or followed by any numbers of cyphers, ſuch as the numbers 367500, .002795, &c. The index, however, is not put down; but it is eaſily ſupplied by the rule which has juſt now been given. The table alſo contains the differences of the logarithms of all numbers from 1000 to 10,000, by means of which the logarithm of any number conſiſting of five figures may be eaſily obtained.

1. *To find the logarithm of any number conſiſting of four or any ſmaller number of figures.* Look for the number in the columns titled at the top *Numbers*; and in the ſame line with it, on the right, in the column of logarithms, will be found the decimal part of its logarithm, to which ſupply the decimal point, and its index according to rule delivered above. Thus,

The log. of 9 is found to be	0.95424
of 17	1.23045
of 2.63	0.41996
of 13.42	1.12775
of 6280	3.79796
of 3749	3.57392
of .6027	$\bar{1}$.78010
of .00234	$\bar{3}$.36922
of 852600	5.93075

2. *To find the logarithm of a number conſiſting of five figures.*

Find the decimal part of the logarithm of the firſt four figures of the number, (that is, find the logarithm of the propoſed number as if the laſt figure were a cypher), by the preceding rule, and find the difference between that logarithm and the next greater, as given in the column of differences (to the right of the column of logarithms). Then ſtate this proportion:

As 10,
To the tabular difference,
So is the laſt, or fifth figure of the number,
To a fourth proportional;

which being added to the former logarithm, and the decimal point and index ſupplied, will be the logarithm ſought.

Example. Required the logarithm of 186.47. The decimal part of the logarithm of the firſt four figures, viz. 1864, is .27045, and the difference oppoſite to it in the column marked D on the top is 23. Therefore we have this proportion:

$$10:23::7:\frac{7\times23}{10}=16.1$$

The fourth proportional is 16.1, or, rejecting the decimal part, .16 nearly; therefore,

to log. of 1684	.27045
add	16
the log. of 168.47 is	2.27061

Description and Use of the Table.

3. *To find the logarithm of a vulgar fraction or mixt number.*

Either reduce the vulgar fraction to a decimal, and find its logarithm as above, or else (having reduced the mixt number to an improper fraction) subtract the logarithm of the denominator from the logarithm of the numerator, and the remainder will be the logarithm of the fraction sought.

Ex. 1. To find the logarithm of $\frac{3}{16}$.

From the log. of 3	0.47712
Subtract the log. of 16	1.20412
Rem. log. of $\frac{3}{16}$ or of .1875	$\bar{1}$.27300

Here, as the lower number is greater than the upper, the remainder must be negative; the subtraction, however, is so performed, that the decimal part of the remainder is positive, and the integer negative.

Ex. 2. To find the logarithm of $13\frac{3}{4}$ or $\frac{55}{4}$.

From log. of 55	1.74036
Subtract log. of 4	0.60206
Rem. log. of $13\frac{3}{4}$ or of 13.75	1.13830

4. *To find the number corresponding to any given logarithm.*

Seek the decimal part of the proposed logarithm in the column of logarithms, and if it be found exactly, the figures of the number corresponding to it will be found in the same line with it in the column of numbers. If the index of the given logarithm is 3, the four figures of the numbers thus found are integers; but if it be 2, the three first figures are integers, and the fourth is a decimal, and so on; the number of integer figures before the decimal point being always one greater than the index, if it be positive; but if it be negative, the number sought will be a decimal, and the number of cyphers between the decimal point and first significant figure will be one less than the index.—*Examples.* The number corresponding to the logarithm 3.57392 is 3749. The number corresponding to 1.12775 is 13.42. The number corresponding to $\bar{3}$.36922 is .00234, and so on.

But if the given logarithm is not exactly found in the table, subtract the next less tabular logarithm from it, and take the difference between that logarithm, and the next greater (as given in the column of differences). Then state this proportion:

As the difference, taken from the table,
Is to 10,
So is the difference between the given logarithm and the next less,
To a fourth proportional,

which being annexed to the four figures corresponding to the logarithm next less than the given one, will be the logarithm required.

Example. Find the number answering to the logarithm 4.13278.

Description and Use of the Table.

The dec. part of given log. is	.13278
That of next less, viz. log. of 1357, is	.13258
Difference	20

The tabular difference is 32, therefore we have this proportion,

$$32 : 10 :: 20 : \frac{20 \times 10}{32} = 6 \text{ nearly.}$$

Therefore the number corresponding to the proposed logarithm is .13576.

In like manner may the numbers to the following logarithms be found.

Logarithms.	Numbers.
1.23457	17.162
$\bar{3}$.73430	5423.8
$\bar{1}$.09214	.12363
4.61230	40954

The *table of logarithms of numbers* is followed by a *Table of logarithmic Sines and Tangents, for every minute of the quadrant, with their differences.* For the explanation of this table we refer to TRIGONOMETRY, to which branch of mathematics it is intended to be applied.

We shall now give practical rules, illustrated by examples, for performing the different operations of arithmetic by logarithms.

MULTIPLICATION BY LOGARITHMS.

RULE.

TAKE out the logarithms of the factors from the table; then add them together, and their sum will be the logarithm of the product required. Then find, by inspection of the table, the natural number answering to their sum, and it will be the product required.

Observing to add what is to be carried from the decimal part of the logarithm to the positive index or indices, or else subtract it from the negative.

Also adding the indices together when they are of the same kind, that is, both positive or both negative; but subtracting the less from the greater when the one is positive and the other negative, and prefixing the sign of the greater to the remainder.

EXAMPLES.

Ex. 1. To multiply 2.314 by 50.62.

	Numbers.	Logarithms.
	2.314	0.36436
	50.62	1.70432
Product	117.13	2.06868

Ex. 2. To multiply 2.5819 by 3.4573.

	Numbers.	Logarithms.
	2.5819	0.41194
	3.4573	0.53874
Prod.	8.9265	0.95068

Ex. 3.

Description and Use of the Table.

Ex. 3. To multiply 39.02, and 597.16, and .03147 together.

Numbers.	Logarithms.
39.02	1.59129
597.16	2.77609
.03147	$\bar{2}$.49790
Prod. 733.3	2.86528

Here the sum of the positive indices, together with 1 which we carry, is 4, and from this we subtract 2, because of the negative index —2.

Ex. 4. To multiply 3.586 and 2.1046, and 0.8372 and 0.0294 all together.

Numbers.	Logarithms.
3.586	0.55461
2.1046	0.32317
0.8372	$\bar{1}$.92283
0.0294	$\bar{2}$.46835
	$\bar{1}$.26896

Here the 2 to carry cancels the —2, and there remains the —1 to set down.

DIVISION by Logarithms.

Rule.

Subtract the logarithm of the divisor from the logarithm of the dividend, and the number answering to the remainder will be the logarithm of the quotient required.

Observing to change the sign of the index of the divisor from positive to negative, or from negative to positive; then take the sum of the indices if they be of the same name, or their difference when they have different signs, with the sign of the greater for the index to the logarithm of the quotient.

Also, when 1 is borrowed in the left-hand place of the decimal part of the logarithm, add it to the index of the divisor when that index is positive, but subtract it when negative; then let the index arising from thence be changed, and work with it as before.

Examples.

Ex. 1. To divide 24163 by 4567.

Numbers.	Logarithms.
Divid. 24163	4.38315
Divis. 4567	3.65963
Quot. 5.2908	0.72352

Ex. 2. To divide 37.15 by 523.76.

Numbers.	Logarithms.
Divid. 37.15	1.56996
Div. 523.76	2.71913
Quot. .07093	$\bar{2}$.85083

Ex. 3. Divide .06314 by .007241.

Numbers.	Logarithms.
Divid. .06314	$\bar{2}$.80030
Divis. .007241	$\bar{3}$.85980
Quot. 8.720	0.94050

Here 1 carried from the decimals to the —3 makes it —2, which taken from the other —2, leaves 0 remaining.

Ex. 4. Divide .7438 by 12.947.

Numbers.	Logarithms.
Divid. .7438	$\bar{1}$.87146
Divis. 12.947	1.11218
Quot. .057449	$\bar{2}$.75928

Here the 1 taken from the —1 makes it become —2 to set down.

PROPORTION by Logarithms.

Rule.

Add the logarithms of the second and third terms, and from the sum subtract the logarithm of the first term by the foregoing rules, the remainder will be the logarithm of the fourth term required.

Or in any compound proportion whatever, add together the logarithms of all the terms that are to be multiplied; and from that sum take the sum of the others, the remainder will be the logarithm of the answer.

But, instead of subtracting any logarithm, we may add its *arithmetical complement*, and the result will be the same. By the arithmetical complement is meant the logarithm of the reciprocal of the given number, or the remainder by taking the given logarithm from 0, or from 10, changing the beginning of the scale from 0 to 10; the easiest way of doing which is to begin at the left hand, and subtract each figure from 9, except the last significant figure on the right hand, which must be subtracted from 10. But when the index is negative, it must be added to 9, and the rest subtracted as before; and for every complement that is added subtract 10 from the last sum of the indices.

Examples.

Ex. 1. Find a fourth proportional to 72.34, 2.519, and 357.48.

Numbers.	Logarithms.
As 72.34	1.85938
To 2.519	0.40123
So is 357.48	2.55325
	2.95448
To 12.448	1.09510

Here the logarithms of the second and third terms are added together, and the logarithm of the first term is subtracted from the sum; but by taking the arithmeti-

cal

Description and Use of the Table.

cal complement of the first term, the work might stand thus:

As	72.34	Comp. log.	8.14062
To	2.519		0.40123
So is	357.48		2.55325
To	12.448		1.09510

Ex. 2. If the interest of 100l. for a year, or 365 days, be 4.5, What will be the interest of 279.25l. for 274 days.

As	100	Comp. log.	8.00000
	365		7.43771
To	279.25		2.44599
	274		2.43775
So is	4.5		0.65321
To	9.4333		0.97466

Here, instead of subtracting the sum of the logarithms of 100 and 365, we add the arithmetical complement of the logarithms of these numbers, and subtract 20 from the sum of the indices.

INVOLUTION by Logarithms.

Rule.

Multiply the logarithm of the given number by the index of the power, and the number answering to the product will be the power required.

Note.—In multiplying a logarithm with a negative index by a positive number, the product will be negative. But what is to be carried from the decimal part of the logarithm will always be positive. And therefore the difference will be the index of the product, and is always to be made of the same kind with the greater.

Examples.

Ex. 1. To square the number 2.579.

	Number.	Logarithm.
Root	2.569	0.41145
The index		2
Power	6.6513	0.82290

Ex. 2. To find the cube of 3.0715.

	Number.	Logarithm.
Root	3.0715	0.48735
The index		3
Power	28.976	1.46205

Ex. 3. To raise .09163 to the fourth power.

	Number.	Logarithm.
Root	.09163	$\bar{2}$.96204
		4
Power	.000070495	$\bar{5}$.84816

Here 4 times the negative index being —8, and 3 to carry, the difference —5, is the index of the product.

Description and Use of the Table.

Ex. 4. To raise 1.0045 to the 365th power.

	Number.	Logarithm.
Root	1.0045	0.00195
The index		365
		975
		1170
		585
Power.	5.1493	.71175

EVOLUTION by Logarithms.

Rule.

Divide the logarithm of the number by the index of the root, and the number answering to the quotient is the root sought.

When the index of the logarithm to be divided is negative, and does not exactly contain the divisor without some remainder, increase the index by such a number as will make it exactly divisible by the index of the root, carrying the units borrowed as so many tens to the left-hand place of the decimal, and then divide as in whole numbers.

Examples.

Ex. 1. Find the square root of 2.

	Number.	Logarithm.
Power	.2	2)0.30103
Root	1.4142	0.15051

Ex. 2. Find the 10th root of 365.

	Number.	Logarithm.
Power	365	10)2.56229
Root	1.804	0.25623

Ex. 3. To find $\sqrt{}$.093.

	Number.	Logarithm.
Power	.093	2)$\bar{2}$.96848
Root	.30496	$\bar{1}$.48424

Here the divisor 2 is contained exactly in the negative index —2, and therefore the index of the quotient is —1.

Ex. 4. To find $^3\sqrt{}$.00048.

	Number.	Logarithm.
Power	.00048	3)$\bar{4}$.68124
Root	.078298	$\bar{2}$.89375

Here the divisor 3, not being exactly contained in —4, it is augmented by 2 to make up 6, in which the divisor is contained just 2 times, then the 2 thus borrowed being carried to the decimal figure 6, makes 26, which divided by 3 gives 8, &c.

N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.
		60	77815	120	07918	180	25527	240	38021	300	47712	360	55630	420	62325
1	00000	61	78533	121	08279	181	25768	241	38202	301	47857	361	55751	421	62428
2	30103	62	79239	122	08636	182	26007	242	28382	302	48001	362	55871	422	62531
3	47712	63	79934	123	08991	183	26245	243	38561	303	48144	363	55991	423	62634
4	60206	64	80618	124	09342	184	26482	244	38739	304	48287	364	56110	424	62737
5	69897	65	81291	125	09691	185	26717	245	38917	305	48430	365	56229	425	62839
6	77815	66	81954	126	10037	186	26951	246	39094	306	48572	366	56348	426	62941
7	84510	67	82607	127	10380	187	27184	247	39270	307	48714	367	56467	427	63043
8	90309	68	83251	128	10721	188	27416	248	39445	308	48855	368	56585	428	63144
9	95424	69	83885	129	11059	189	27646	249	39620	309	48996	369	56703	429	63246
10	00000	70	84510	130	11394	190	27875	250	39794	310	49136	370	56820	430	63347
11	04139	71	85126	131	11727	191	28103	251	39967	311	49276	371	56937	431	63448
12	07918	72	85733	132	12057	192	28330	252	40140	312	49415	372	57054	432	63548
13	11394	73	86332	133	12385	193	28556	253	40312	313	49554	373	57171	433	63649
14	14613	74	86923	134	12710	194	28780	254	40483	314	49693	374	57287	434	63749
15	17609	75	87506	135	13033	195	29003	255	40654	315	49831	375	57403	435	63849
16	20412	76	88081	136	13354	196	29226	256	40824	316	49969	376	57519	436	63949
17	23045	77	88649	137	13672	197	29447	257	40993	317	50106	377	57634	437	64048
18	25527	78	89209	138	13988	198	29667	258	41162	318	50243	378	57749	438	64147
19	27875	79	89763	139	14301	199	29885	259	41330	319	50379	379	57864	439	64246
20	30103	80	90309	140	14613	200	30103	260	41497	320	50515	380	57978	440	64345
21	32222	81	90849	141	14922	201	30320	261	41664	321	50651	381	58092	441	64444
22	34242	82	91381	142	15229	202	30535	262	41830	322	50786	382	58206	442	64542
23	36173	83	91908	143	15534	203	30750	263	41996	323	50920	383	58320	443	64640
24	38021	84	92428	144	15836	204	30963	264	42160	324	51055	384	58433	444	64738
25	39794	85	92942	145	16137	205	31175	265	42325	325	51188	385	58546	445	64836
26	41497	86	93450	146	16435	206	31387	266	42488	326	51322	386	58659	446	64933
27	43136	87	93952	147	16732	207	31597	267	42651	327	51455	387	58771	447	65031
28	44716	88	94448	148	17026	208	31806	268	42813	328	51587	388	58883	448	65128
29	46240	89	94939	149	17319	209	32015	269	42975	329	51720	389	58995	449	65225
30	47712	90	95424	150	17609	210	32222	270	43136	330	51851	390	59106	450	65321
31	49136	91	95904	151	17898	211	32428	271	43297	331	51983	391	59218	451	65418
32	50515	92	96379	152	18184	212	32634	222	43457	332	52114	392	59329	452	65514
33	51851	93	96848	153	18469	213	32838	273	43616	333	52244	393	59439	453	65610
34	53148	94	97313	154	18752	214	33041	264	43775	334	52375	394	59550	454	65706
35	54407	95	97772	155	19033	215	33244	275	43933	335	52504	395	59660	455	65801
36	55630	96	98227	156	19312	216	33445	276	44091	336	52634	396	59770	456	65896
37	56820	97	98677	157	19590	217	33646	277	44248	337	52763	397	59879	457	65992
38	57978	98	99123	158	19866	218	33846	278	44404	338	52892	398	59988	458	66087
39	59106	99	99564	159	20140	219	34044	279	44560	339	53020	399	60097	459	66181
40	60206	100	00000	160	20412	220	34242	280	44716	340	53148	400	60206	460	66276
41	61278	101	00432	161	20683	221	34439	281	44871	341	53275	401	60314	461	66370
42	62325	102	00860	162	20952	222	34635	282	45025	342	53403	402	60423	462	66464
43	63347	103	01284	163	21219	223	34830	283	45179	343	53529	403	60531	463	66558
44	64345	104	01703	164	21484	224	35025	284	45332	344	53656	404	60638	464	66652
45	65321	105	02119	165	21748	225	35218	285	45484	345	53782	405	60746	465	66745
46	66276	106	02531	166	22011	226	35411	286	45637	346	53908	406	60853	466	66839
47	67210	107	02938	167	22272	227	35603	287	45788	347	54033	407	60959	467	66932
48	68124	108	03342	168	22531	228	35793	288	45939	348	54158	408	61066	468	67025
49	69020	109	03743	169	22789	229	35984	289	46060	349	54283	409	61172	469	67117
50	69897	110	04139	170	23045	230	36173	290	46240	350	54407	410	61278	470	67210
51	70757	111	04532	171	23300	231	36361	291	46389	351	54531	411	61384	471	67302
52	71600	112	04922	172	23553	232	36549	292	46538	352	54654	412	61490	472	67394
53	72428	113	05308	173	23805	233	36736	293	46687	353	54777	413	61595	473	67486
54	73239	114	05690	174	24055	234	36922	294	46835	354	54900	414	61700	474	67578
55	74036	115	06070	175	24304	235	37107	295	46982	355	55023	415	61805	475	67669
56	74819	116	06446	176	24551	236	37291	296	47129	356	55145	416	61909	476	67761
57	75587	117	06819	177	24797	237	37475	297	47276	357	55267	417	62014	477	67852
58	76343	118	07188	178	25042	238	37658	298	47422	358	55388	418	62118	478	67943
59	77085	119	07555	179	25285	239	37840	299	47567	359	55509	419	62221	479	68034
60	77815	120	07918	180	25527	240	38021	300	47712	360	55630	420	62325	480	68124

N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.
480	68124	540	73239	600	77815	660	81954	720	85733	780	89209	840	92428	900	95424
481	68215	541	73320	601	77887	661	82020	721	85794	781	89265	841	92480	901	95472
482	68305	542	73400	602	77960	662	82086	722	85854	782	89321	842	92531	902	95521
483	68395	543	73480	603	78032	663	82151	723	85914	783	89376	843	92583	903	95569
484	68485	544	73560	604	78104	664	82217	724	85974	784	89432	844	92634	904	95617
485	68574	545	73640	605	78176	665	82282	725	86034	785	89487	845	92686	905	95665
486	68664	546	73719	606	78247	666	82347	726	86094	786	89542	846	92737	906	95713
487	68753	547	73799	607	78319	667	82413	727	86153	787	89597	847	92788	907	95761
488	68842	548	73878	608	78390	668	82478	728	86213	788	89653	848	92840	908	95809
489	68931	549	73957	609	78462	669	82543	729	86273	789	89708	849	92891	909	95856
490	69020	550	74036	610	78533	670	82607	730	86332	790	89763	850	92942	910	95904
491	69108	551	74115	611	78604	671	82672	731	86392	791	89818	851	92993	911	95952
492	69197	552	74194	612	78675	672	82737	732	86451	792	89873	852	93044	912	95999
493	69285	553	74273	613	78746	673	82802	733	86510	793	89927	853	93095	913	96047
494	69373	554	74351	614	78817	674	82866	734	86570	794	89982	854	93146	914	96095
495	69461	555	74429	615	78888	675	82930	735	86629	795	90037	855	93197	915	96142
496	69548	556	74507	616	78958	676	82995	736	86688	796	90091	856	93247	916	96190
497	69636	557	74586	617	79029	677	83059	737	86747	797	90146	857	93298	917	96237
498	69723	558	74663	618	79099	678	83123	738	86806	798	90200	858	93349	918	96284
449	69810	559	74741	619	79169	679	83187	739	86864	799	90255	859	93399	919	96332
500	69897	560	74819	620	79239	680	83251	740	86923	800	90309	860	93450	920	96379
501	69984	561	74896	621	79309	681	83315	741	86982	801	90363	861	93500	921	96426
502	70070	562	74974	622	79379	682	83378	742	87040	802	90417	862	93551	922	96473
503	70157	563	75051	623	79449	683	83442	743	87099	803	90472	863	93601	923	96520
504	70243	564	75128	624	79518	684	83506	744	87157	804	90526	864	93651	924	96567
505	70329	565	75205	625	79588	685	83569	745	87216	805	90580	865	93702	925	96614
506	70415	566	75282	626	79657	686	83632	746	87274	806	90634	866	93752	926	96661
507	70501	567	75358	627	79727	687	83696	747	87332	807	90687	867	93802	927	96708
508	70586	568	75435	628	79796	688	83759	748	87390	808	90741	868	93852	928	96755
509	70672	569	75511	629	79865	689	83822	749	87448	809	90795	869	93902	929	96802
510	70757	570	75587	630	79934	690	83885	750	87506	810	90849	870	93952	930	96848
511	70842	571	75664	631	80003	691	83948	751	87564	811	90902	871	94002	931	96895
512	70927	572	75740	632	80072	692	84011	752	87622	812	90956	872	94052	932	96942
513	71012	573	75815	633	80140	693	84073	753	87679	813	91009	873	94101	933	96988
514	71096	574	75891	634	80209	694	84136	754	87737	814	91062	874	94151	934	97035
515	71181	575	75967	635	80277	695	84198	755	87795	815	91116	875	94201	935	97081
516	71265	576	76042	636	80346	696	84261	756	87852	816	91169	876	94250	936	97128
517	71349	577	76118	637	80414	697	84323	757	87910	817	91222	877	94300	937	97174
518	71433	578	76193	638	80482	698	84386	758	87967	818	91275	878	94349	938	97220
519	71517	579	76268	639	80550	699	84448	759	88024	819	91328	879	94399	939	97267
520	71600	580	76343	640	80618	700	84510	760	88081	820	91381	880	94448	940	97313
521	71684	581	76418	641	80686	701	84572	761	88138	821	91434	881	94498	941	97359
522	71767	582	76492	642	80754	702	84634	762	88195	822	91487	882	94547	942	97405
523	71850	583	76567	643	80821	703	84696	763	88252	823	91540	883	94596	943	97451
524	71933	584	76641	644	80889	704	84757	764	88309	824	91593	884	94645	944	97497
525	72016	585	76716	645	80956	705	84819	765	88366	825	91645	885	94694	945	97543
526	72099	586	76790	646	81023	706	84880	766	88423	826	91698	886	94743	946	97589
527	72181	587	76864	647	81090	707	84942	767	88480	827	91751	887	94792	947	97635
528	72263	588	76938	648	81158	708	85003	768	88536	828	91803	888	94841	948	97681
529	72346	589	77012	649	81224	709	85065	769	88593	829	91855	889	94890	449	97727
530	72428	590	77085	650	81291	710	85126	770	88649	830	91908	890	94939	950	97772
531	72509	591	77159	651	81358	711	85187	771	88705	831	91960	891	94988	951	97818
532	72591	592	77232	652	81425	712	85248	772	88762	832	92012	892	95036	952	97864
533	72673	593	77305	653	81491	713	85309	773	88818	833	92065	893	95085	953	97909
534	72754	594	77379	654	81558	714	85370	774	88874	834	92117	894	95134	954	97955
535	72835	595	77452	655	81624	715	85431	775	88930	835	92169	895	95182	955	98000
536	72916	596	77525	656	81690	716	85491	776	88986	836	92221	896	95231	956	98046
537	72997	597	77597	657	81757	717	85552	777	89042	837	92273	897	95279	957	98091
538	73078	598	77670	658	81823	718	85612	778	89098	838	92324	898	95328	958	98137
539	73159	599	77743	659	81889	719	85673	779	89154	839	92376	899	95376	959	98182
540	73239	600	77815	660	81954	720	85733	780	89209	840	92428	900	95424	960	98227

N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.
960	98227		1020	00860	43	1080	03342	41	1140	05690	39	1200	07918	36	1260	10037	35	1320	12057	33	1380	13988	31
961	98272		1021	00903	42	1081	03383	40	1141	05729	38	1201	07954	36	1261	10072	34	1321	12090	33	1381	14019	32
962	98318		1022	00945	43	1082	03423	40	1142	05767	38	1202	07990	37	1262	10106	34	1322	12123	33	1382	14051	31
963	98363		1023	00988	42	1083	03463	40	1143	05805	38	1203	08027	36	1263	10140	35	1323	12156	33	1383	14082	32
964	98408		1024	01030	42	1084	03503	40	1144	05843	38	1204	08063	36	1264	10175	34	1324	12189	33	1384	141[illegible]	31
965	98453		1025	01072	43	1085	03543	40	1145	05881	37	1205	08099	36	1265	10209	34	1325	12222	32	1385	14145	31
966	98498		1026	01115	42	1086	03583	40	1146	05918	38	1206	08135	36	1266	10243	35	1326	12254	33	1386	14176	32
967	98543		1027	01157	42	1087	03623	40	1147	05956	38	1207	08171	36	1267	10278	34	1327	12287	33	1387	14208	31
968	98588		1028	01199	43	1088	03663	40	1148	05994	38	1208	08207	36	1268	10312	34	1328	12320	32	1388	14239	31
969	98632		1029	01242	42	1089	03703	40	1149	06032	38	1209	08243	36	1269	10346	34	1329	12352	33	1389	14270	31
970	98677		1030	01284	42	1090	03743	39	1150	06070	38	1210	08279	35	1270	10380	35	1330	12385	33	1390	14301	32
971	98722		1031	01326	42	1091	03782	40	1151	06108	37	1211	08314	36	1271	10415	34	1331	12418	32	1391	14333	31
972	98767		1032	01368	42	1092	03822	40	1152	06145	38	1212	08350	36	1272	10449	34	1332	12450	33	1392	14364	31
973	98811		1033	01410	42	1093	03862	40	1153	06183	38	1213	08386	36	1273	10483	34	1333	12483	33	1393	14395	31
974	98856		1034	01452	42	1094	03902	39	1154	06221	37	1214	08422	36	1274	10517	34	1334	12516	32	1394	14426	31
975	98900		1035	01494	42	1095	03941	40	1155	06258	38	1215	08458	35	1275	10551	34	1335	12548	33	1395	14457	32
976	98945		1036	01536	42	1096	03981	40	1156	06296	37	1216	08493	36	1276	10585	34	1336	12581	32	1396	14489	31
977	98989		1037	01578	42	1097	04021	39	1157	06833	38	1217	08529	36	1277	10619	34	1337	12613	33	1397	14520	31
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4804	68160	9	4864	68699	9	4924	69232	9	4984	69758	9
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4806	68178	9	4866	68717	9	4926	69249	9	4986	69775	9
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4809	68205	10	4869	68744	9	4929	69276	9	4989	69801	9
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4813	68242	9	4873	68780	9	4933	69311	9	4993	69836	9
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4815	68260	9	4875	68797	9	4935	69329	9	4995	69854	8
4816	68269	9	4876	68806	9	4936	69338	8	4996	69862	9
4817	68278	9	4877	68815	9	4937	69346	9	4997	69871	9
4818	68287	9	4878	68824	9	4938	69355	9	4998	69880	8
4819	68296	9	4879	68833	9	4939	69364	9	4999	69888	9
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4821	68314	9	4881	68851	9	4941	69381	9	5001	69906	8
4822	68323	9	4882	68860	9	4942	69390	9	5002	69914	9
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4828	68377	9	4888	68913	9	4948	69443	9	5008	69966	9
4829	68386	9	4889	68922	9	4949	69452	9	5009	69975	9
4830	68395	9	4890	68931	9	4950	69461	8	5010	69984	8
4831	68404	9	4891	68940	9	4951	69469	9	5011	69992	9
4832	68413	9	4892	68949	9	4952	69478	9	5012	70001	9
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4834	68431	9	4894	68966	9	4954	69496	8	5014	70018	9
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4836	68449	9	4896	68984	9	4956	69513	9	5016	70036	8
4837	68458	9	4897	68993	9	4957	69522	9	5017	70044	9
4838	68467	9	4898	69002	9	4958	69531	8	5018	70053	9
4839	68476	9	4899	69011	9	4959	69539	9	5019	70062	8
4840	68485	9	4900	69020	8	4960	69548	9	5020	70070	9
4841	68494	8	4901	69028	9	4961	69557	9	5021	70079	9
4842	68502	9	4902	69037	9	4962	69566	8	5022	70088	8
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4850	68574	9	4910	69108	9	4970	69636	8	5030	70157	8
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4852	68592	9	4912	69126	9	4972	69653	9	5032	70174	9
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4856	68628	9	4916	69161	9	4976	69688	9	5036	70209	8
4857	68637	9	4917	69170	9	4977	69697	8	5037	70217	9
4858	68646	9	4918	69179	9	4978	69705	9	5038	70226	8
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4860	68664		4920	69197		4980	69723		5040	70243	

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5339	72746	8	5399	73231	8	5459	73711	8	5519	74186	8	5579	74656	7	5639	75120	8	5699	75580	7	5759	76035	7
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6246	79560	7	6306	79975	7	6366	80387	6	6426	80794	7	6486	81198	6	6546	81598	6	6606	81994	6	6666	82387	6
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6721	82743	7	6781	83129	7	6841	83512	6	6901	83891	6	6961	84267	6	7021	84640	6	7081	85009	7	7141	85376	6
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6724	82763	6	6784	83149	6	6844	83531	6	6904	83910	6	6964	84286	6	7024	84658	7	7084	85028	6	7144	85394	6
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6726	82776	6	6786	83161	7	6846	83544	6	6906	83923	6	6966	84298	7	7026	84671	6	7086	85040	6	7146	85406	6
6727	82782	7	6787	83168	6	6847	83550	6	6907	83929	6	6967	84305	6	7027	84677	6	7087	85046	6	7147	85412	6
6728	82789	6	6788	83174	7	6848	83556	7	6908	83935	7	6968	84311	6	7028	84683	6	7088	85052	6	7148	85418	7
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6775	83091	6	6835	83474	6	6895	83853	7	6955	84230	6	7015	84603	6	7075	84973	6	7135	85339	6	7195	85703	6
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7206	85769	6	7266	86130	6	7326	86487	6	7386	86841	6	7446	87192	6	7506	87541	6	7566	87887	5	7626	88230	5
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7209	85788	6	7269	86147	6	7329	86504	6	7389	86859	5	7449	87210	6	7509	87558	6	7569	87904	6	7629	88247	5
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7225	85884	6	7285	86243	6	7345	86599	6	7405	86953	5	7465	87303	6	7525	87651	5	7585	87996	5	7645	88338	5
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7227	85896	6	7287	86255	6	7347	86611	6	7407	86964	6	7467	87315	5	7527	87662	6	7587	88007	6	7647	88349	6
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7232	85926	6	7292	86285	6	7352	86641	5	7412	86994	5	7472	87344	5	7532	87691	6	7592	88036	5	7652	88377	6
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7235	85944	6	7295	86303	5	7355	86658	6	7415	87011	6	7475	87361	6	7535	87708	6	7595	88053	5	7655	88395	5
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7241	85980	6	7301	86338	6	7361	86694	6	7421	87046	6	7481	87396	6	7541	87743	6	7601	88087	6	7661	88429	5
7242	85986	6	7302	86344	6	7362	86700	5	7422	87052	6	7482	87402	6	7542	87749	5	7602	88093	5	7662	88434	6
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7246	86010	6	7306	86368	6	7366	86723	6	7426	87075	6	7486	87425	6	7546	87772	5	7606	88116	5	7666	88457	6
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7248	86022	6	7308	86380	6	7368	86735	6	7428	87087	6	7488	87437	5	7548	87783	6	7608	88127	6	7668	88468	6
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7251	86040	6	7311	86398	6	7371	86753	6	7431	87105	6	7491	87454	6	7551	87800	6	7611	88144	6	7671	88485	6
7252	86046	6	7312	86404	6	7372	86759	5	7432	87111	5	7492	87460	6	7552	87806	6	7612	88150	6	7672	88491	6
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7254	86058	6	7314	86415	6	7374	86770	6	7434	87122	6	7494	87471	6	7554	87818	5	7614	88161	6	7674	88502	6
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7257	86076	6	7317	86433	6	7377	86788	6	7437	87140	6	7497	87489	6	7557	87835	6	7617	88178	6	7677	88519	6
7258	86082	6	7318	86439	6	7378	86794	6	7438	87146	5	7498	87495	5	7558	87841	5	7618	88184	6	7678	88525	5
7259	86088	6	7319	86445	6	7379	86800	6	7439	87151	6	7499	87500	6	7559	87846	6	7619	88190	5	7679	88530	6
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7681	88542	5	7741	88880	5	7801	89215	6	7861	89548	5	7921	89878	5	7981	90206	5	8041	90531	5	8101	90854	5
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7683	88553	6	7743	88891	6	7803	89226	6	7863	89559	5	7923	89889	5	7983	90217	5	8043	90542	5	8103	90865	5
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8643	93666	5	8703	93967	5	8763	94265	5	8823	94562	5	8883	94856	5	8943	95148	5	9003	95436	5	9063	95727	5
8644	93671	5	8704	93972	5	8764	94270	5	8824	94567	4	8884	94861	5	8944	95153	5	9004	95444	4	9064	95732	5
8645	93676	6	8705	93977	5	8765	94275	5	8825	94571	5	8885	94866	5	8945	95158	5	9005	95448	5	9065	95737	5
8646	93682	5	8706	93982	5	8766	94280	5	8826	94576	5	8886	94871	5	8946	95163	5	9006	95453	5	9066	95742	4
8647	93687	5	8707	93987	5	8767	94285	5	8827	94581	5	8887	94876	4	8947	95168	5	9007	95458	5	9067	95746	5
8648	93692	5	8708	93992	5	8768	94290	5	8828	94586	5	8888	94880	5	8948	95173	4	9008	95463	5	9068	95751	5
8649	93697	5	8709	93997	5	8769	94295	5	8829	94591	5	8889	94885	5	8949	95177	5	9009	95468	4	9069	95756	5
8650	93702	5	8710	94002	5	8770	94300	5	8830	94596	5	8890	92890	5	8950	95182	5	9010	95472	5	9070	95761	5
8651	93707	5	8711	94007	5	8771	94305	5	8831	94601	5	8891	94895	5	8951	95187	5	9011	95477	5	9071	95766	4
8652	93712	5	8712	94012	5	8772	94310	5	8832	94606	5	8892	94900	5	8952	95192	5	9012	95482	5	9072	95770	5
8653	93717	5	8713	94017	5	8773	94315	5	8833	94611	5	8893	94905	5	8953	95197	5	9013	95487	5	9073	95775	5
8654	93722	5	8714	94022	5	8774	94320	5	8834	94616	5	8894	94910	5	8954	95202	5	9014	95492	5	9074	95780	5
8655	93727	5	8715	94027	5	8775	94325	5	8835	94621	5	8895	94915	4	8955	95207	4	9015	95497	4	9075	95785	4
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8657	93737	5	8717	94037	5	8777	94335	5	8837	94630	5	8897	94924	5	8957	95216	5	9017	95506	5	9077	95794	5
8658	93742	5	8718	94042	5	8778	94340	5	8838	94635	5	8898	94929	5	8958	95221	5	9018	95511	5	9078	95799	5
8659	93747	5	8719	94047	5	8779	94345	4	8839	94640	5	8899	94934	5	8959	95226	5	9019	95516	5	9079	95804	5
8660	93752	5	8720	94052	5	8780	94349	5	8840	94645	5	8900	94939	5	8960	95231	5	9020	95521	4	9080	95809	4
8661	93757	5	8721	94057	5	8781	94354	5	8841	94650	5	8901	94944	5	8961	95236	4	9021	95525	5	9081	95813	5
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8665	93777	5	8725	94077	5	8785	94374	5	8845	94670	5	8905	94963	5	8965	95255	5	9025	95545	5	9085	95832	5
8666	93782	5	8726	94082	4	8786	94379	5	8846	94675	5	8906	94968	5	8966	95260	5	9026	95550	4	9086	95837	5
8667	93787	5	8727	94086	5	8787	94384	5	8847	94680	5	8907	94973	5	8967	95265	5	9027	95554	5	9087	95842	5
8668	93792	5	8728	94091	5	8788	94389	5	8848	94685	4	8908	94978	5	8968	95270	4	9028	95559	5	9088	95847	5
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8670	93802	5	8730	94101	5	8790	94499	5	8850	94694	5	8910	94988	5	8970	95279	5	9030	95569	5	9090	95856	5
8671	93807	5	8731	94106	5	8791	94404	5	8851	94699	5	8911	94993	5	8971	95284	5	9031	95574	4	9091	95861	5
8672	93812	5	8732	94111	5	8792	94409	5	8852	94704	5	8912	94998	4	8972	95289	5	9032	95578	5	9092	95866	5
8673	93817	5	8733	94116	5	8793	94414	5	8853	94709	5	8913	95002	5	8973	95294	5	9033	95583	5	9093	95871	4
8674	93822	5	8734	94121	5	8794	94419	5	8854	94714	5	8914	95007	5	8974	95299	4	9034	95588	5	9094	95875	5
8675	93827	5	8735	94126	5	8795	94424	5	8855	94719	5	8915	95012	5	8975	95303	5	9035	95593	5	9095	95880	5
8676	93832	5	8736	94131	5	8796	94429	4	8856	94724	5	8916	95017	5	8976	95308	5	9036	95598	4	9096	95885	5
8677	93837	5	8737	94136	5	8797	94433	5	8857	94729	5	8917	95022	5	8977	95313	5	9037	95602	5	9097	95890	5
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8682	93862	5	8742	94161	5	8802	94458	5	8862	94753	5	8922	95046	5	8982	95337	5	9042	95626	5	9102	95914	4
8683	93867	5	8743	94166	5	8803	94463	5	8863	94758	5	8923	95051	5	8983	95342	5	9043	95631	5	9103	95918	5
8684	93872	5	8744	94171	5	8804	94468	5	8864	94763	5	8924	95056	5	8984	95347	5	9044	95636	5	9104	95923	5
8685	93877	5	8745	94176	5	8805	94473	5	8865	94768	5	8925	95061	5	8985	95352	5	9045	95641	5	9105	95928	5
8686	93882	5	8746	94181	5	8806	94478	5	8866	94773	5	8926	95066	5	8986	95357	4	9046	95646	4	9106	95933	5
8687	93887	5	8747	94186	5	8807	94483	5	8867	94778	5	8927	95071	4	8987	95361	5	9047	95650	5	9107	95938	4
8688	93892	5	8748	94191	5	8808	94488	5	8868	94783	4	8928	95075	5	8988	95366	5	9048	95655	5	9108	95942	5
8689	93897	5	8749	94196	5	8809	94493	5	8869	94787	5	8929	95080	5	8989	95371	5	9049	95660	5	9109	95947	5
8690	93902	5	8750	94201	5	8810	94498	5	8870	94792	5	8930	95085	5	8990	95376	5	9050	95665	5	9110	95952	5
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8692	93912	5	8752	94211	5	8812	94507	5	8872	94802	5	8932	95095	5	8992	95386	4	9052	95674	5	9112	95961	5
8693	93917	5	8753	94216	5	8813	94512	5	8873	94807	5	8933	95100	5	8993	95390	5	9053	95679	5	9113	95966	5
8694	93922	5	8754	94221	5	8814	94517	5	8874	94812	5	8934	95105	4	8994	95395	5	9054	95684	5	9114	95971	5
8695	93927	5	8755	94226	5	8815	94522	5	8875	94817	5	8935	95109	5	8995	95400	5	9055	95689	5	9115	95976	4
8696	93932	5	8756	94231	5	8816	94527	5	8876	94822	5	8936	95114	5	8996	95405	5	9056	95694	4	9116	95980	5
8697	93937	5	8757	94236	4	8817	94532	5	8877	94827	5	8937	95119	5	8997	95410	5	9057	95698	5	9117	95985	5
8698	93942	5	8758	94240	5	8818	94537	5	8878	94832	4	8938	95124	5	8998	95415	4	9058	95703	5	9118	95990	5
8699	93947	5	8759	94245	5	8819	94542	5	8879	94836	5	8939	95129	5	8999	95419	5	9059	95708	5	9119	95995	4
8700	93952		8760	94250		8820	94547		8880	94841		8940	95134		9000	95424		9060	95713		9120	95999	

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9121	96004	5	9181	96289	5	9241	96572	5	9301	96853	5	9361	97132	5	9421	97410	4	9481	97685	5	9541	97959	5
9122	96009	5	9182	96294	4	9242	96577	4	9302	96858	4	9362	97137	5	9422	97414	5	9482	97690	5	9542	97964	4
9123	96014	5	9183	96298	5	9243	96581	5	9303	96862	5	9363	97142	4	9423	97419	5	9483	97695	4	9543	97968	5
9124	96019	4	9184	96303	5	9244	96586	5	9304	96867	5	9364	97146	5	9424	97424	4	9484	97699	5	9544	97973	5
9125	96023	5	9185	96308	5	9245	96591	4	9305	96872	4	9365	97151	4	9425	97428	5	9485	97704	4	9545	97978	4
9126	96028	5	9186	96313	4	9246	96595	5	9306	96876	5	9366	97155	5	9426	97433	4	9486	97708	5	9546	97982	5
9127	96033	5	9187	96317	5	9247	96600	5	9307	96881	5	9367	97160	5	9427	97437	5	9487	97713	4	9547	97987	4
9128	96038	4	9188	96322	5	9248	96605	4	9308	96886	4	9368	97165	4	9428	97442	5	9488	97717	5	9548	97991	5
9129	96042	5	9189	96327	5	9249	96609	5	9309	96890	5	9369	97169	5	9429	97447	4	9489	97722	5	9549	97996	4
9130	96047	5	9190	96332	4	9250	96614	5	9310	96895	5	9370	97174	5	9430	97451	5	9490	97727	4	9550	98000	5
9131	96052	5	9191	96336	5	9251	96619	5	9311	96900	4	9371	97179	4	9431	97456	4	9491	97731	5	9551	98005	4
9132	96057	4	9192	96341	5	9252	96624	4	9312	96904	5	9372	97183	5	9432	97460	5	9492	97736	4	9552	98009	5
9133	96061	5	9193	96346	4	9253	96628	5	9313	96909	5	9373	97188	4	9433	97465	5	9493	97740	5	9553	98014	5
9134	96066	5	9194	96350	5	9254	96633	5	9314	96914	4	9374	97192	5	9434	97470	4	9494	97745	4	9554	98019	4
9135	96071	5	9195	96355	5	9255	96638	4	9315	96918	5	9375	97197	5	9435	97474	5	9495	97749	5	9555	98023	5
9136	96076	4	9196	96360	5	9256	96642	5	9316	96923	5	9376	97202	4	9436	97479	4	9496	97754	5	9556	98028	4
9137	96080	5	9197	96365	4	9257	96647	5	9317	96928	4	9377	97206	5	9437	97483	5	9497	97759	4	9557	98032	5
9138	96085	5	9198	96369	5	9258	96652	4	9318	96932	5	9378	97211	5	9438	97488	5	9498	97763	5	9558	98037	4
9139	96090	5	9199	96374	5	9259	96656	5	9319	96937	5	9379	97216	4	9439	97493	4	9499	97768	4	9559	98041	5
9140	96095	4	9200	96379	5	9260	96661	5	9320	96942	4	9380	97220	5	9440	97497	5	9500	97772	5	9560	98046	4
9141	96099	5	9201	96384	4	9261	96666	4	9321	96946	5	9381	97225	5	9441	97502	4	9501	97777	5	9561	98050	5
9142	96104	5	9202	96388	5	9262	96670	5	9322	96951	5	9382	97230	4	9442	97506	5	9502	97782	4	9562	98055	4
9143	96109	5	9203	96393	5	9263	96675	5	9323	96956	4	9383	97234	5	9443	97511	5	9503	97786	5	9563	98059	5
9144	96114	4	9204	96398	4	9264	96680	5	9324	96960	5	9384	97239	4	9444	97516	4	9504	97791	4	9564	98064	4
9145	96118	5	9205	96402	5	9265	96685	4	9325	96965	5	9385	97243	5	9445	97520	5	9505	97795	5	9565	98068	5
9146	96123	5	9206	96407	5	9266	96689	5	9326	96970	4	9386	97248	5	9446	97525	4	9506	97800	4	9566	98073	5
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9148	96133	4	9208	96417	4	9268	96699	4	9328	96979	5	9388	97257	5	9448	97534	5	9508	97809	4	9568	98082	5
9149	96137	5	9209	96421	5	9269	96703	5	9329	96984	4	9389	97262	5	9449	97539	4	9509	97813	5	9569	98087	4
9150	96142	5	9210	96426	5	9270	96708	5	9330	96988	5	9390	97267	4	9450	97543	5	9510	97818	5	9570	98091	5
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9152	96152	4	9212	96435	5	9272	96717	5	9332	96997	5	9392	97276	4	9452	97552	5	9512	97827	5	9572	98100	5
9153	96156	5	9213	96440	5	9273	96722	5	9333	97002	5	9393	97280	5	9453	97557	5	9513	97832	4	9573	98105	4
9154	96161	5	9214	96445	5	9274	96727	4	9334	97007	4	9394	97285	5	9454	97562	4	9514	97836	5	9574	98109	5
9155	96166	5	9215	96450	4	9275	96731	5	9335	97011	5	9395	97290	4	9455	97566	5	9515	97841	4	9575	98114	4
9156	96171	4	9216	96454	5	9276	96736	5	9336	97016	5	9396	97294	5	9456	97571	4	9516	97845	5	9576	98118	5
9157	96175	5	9217	96459	5	9277	96741	4	9337	97021	4	9397	97299	5	9457	97575	5	9517	97850	5	9577	98123	4
9158	96180	5	9218	96464	4	9278	96745	5	9338	97025	5	9398	97304	4	9458	97580	5	9518	97855	4	9578	98127	5
9159	96185	5	9219	96468	5	9279	96750	5	9339	97030	5	9399	97308	5	9459	97585	4	9519	97859	5	9579	98132	5
9160	96190	4	9220	96473	5	9280	96755	4	9340	97035	4	9400	97313	4	9460	97589	5	9520	97864	4	9580	98137	4
9161	96194	5	9221	96478	5	9281	96759	5	9341	97039	5	9401	97317	5	9461	97594	4	9521	97868	5	9581	98141	5
9162	96199	5	9222	96483	4	9282	96764	5	9342	97044	5	9402	97322	5	9462	97598	5	9522	97873	4	9582	98146	4
9163	96204	5	9223	96487	5	9283	96769	5	9343	97049	4	9403	97327	4	9463	97603	4	9523	97877	5	9583	98150	5
9164	96209	4	9224	96492	5	9284	96774	4	9344	97053	5	9404	97331	5	9464	97606	5	9524	97882	4	9584	98155	4
9165	96213	5	9225	96497	4	9285	96778	5	9345	97058	5	9405	97336	4	9465	97612	5	9525	97886	5	9585	98159	5
9166	96218	5	9226	96501	5	9286	96783	5	9346	97063	4	9406	97340	5	9466	97617	4	9526	97891	5	9586	98164	4
9167	96223	4	9227	96506	5	9287	96788	4	9347	97067	5	9407	97345	5	9467	97621	5	9527	97896	4	9587	98168	5
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9169	96232	5	9229	96515	5	9289	96797	5	9349	97077	4	9409	97354	5	9469	97630	5	9529	97905	4	9589	98177	5
9170	96237	5	9230	96520	5	9290	96802	4	9350	97081	5	9410	97359	5	9470	97635	5	9530	97909	5	9590	98182	4
9171	96242	4	9231	96525	5	9291	96806	5	9351	97086	4	9411	97364	4	9471	97640	4	9531	97914	4	9591	98186	5
9172	96246	5	9232	96530	4	9292	96811	5	9352	97090	5	9412	97368	5	9472	97644	5	9532	97918	5	9592	98191	4
9173	96251	5	9233	96534	5	9293	96816	4	9353	97095	5	9413	97373	4	9473	97649	4	9533	97923	5	9593	98195	5
9174	96256	5	9234	96539	5	9294	96820	5	9354	97100	4	9414	97377	5	9474	97653	5	9534	97928	4	9594	98200	4
9175	96261	4	9235	96544	4	9295	96825	5	9355	97104	5	9415	97382	5	9475	97658	5	9535	97932	5	9595	98204	5
9176	96265	5	9236	96548	5	9296	96830	4	9356	97109	5	9416	97387	4	9476	97663	4	9536	97937	4	9596	98209	5
9177	96270	5	9237	96553	5	9297	96834	5	9357	97114	4	9417	97391	5	9477	97667	5	9537	97941	5	9597	98214	4
9178	96275	5	9238	96558	4	9298	96839	5	9358	97118	5	9418	97396	4	9478	97672	4	9538	97946	4	9598	98218	5
9179	96280	4	9239	96562	5	9299	96844	4	9359	97123	5	9419	97400	5	9479	97676	5	9539	97950	5	9599	98223	4
9180	96284		9240	96567		9300	96848		9360	97128		9420	97405		9480	97681		9540	97955		9600	98227	

N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.	N.	Log.	D.
9600	98227	5	9650	98453	4	9700	98677	5	9750	98900	5	9800	99123	4	9850	99344	4	9900	99564	4	9950	99782	5
9601	98232	4	9651	98457	5	9701	98682	4	9751	98905	4	9801	99127	4	9851	99348	4	9901	99568	4	9951	99787	4
9602	98236	5	9652	98462	4	9702	98686	5	9752	98909	5	9802	99131	5	9852	99352	5	9902	99572	5	9952	99791	4
9603	98241	4	9653	98466	5	9703	98691	4	9753	98914	4	9803	99136	4	9853	99357	4	9903	99577	4	9953	99795	5
9604	98245	5	9654	98471	4	9704	98695	5	9754	98918	5	9804	99140	5	9854	99361	5	9904	99581	4	9954	99800	4
9605	98250	4	9655	98475	5	9705	98700	4	9755	98923	4	9805	99145	4	9855	99366	4	9905	99585	5	9955	99804	4
9606	98254	5	9656	98480	4	9706	98704	5	9756	98927	5	9806	99149	5	9856	99370	4	9906	99590	4	6956	99808	5
9607	98259	4	9657	98484	5	9707	98709	4	9757	98932	4	9807	99154	4	9857	99374	5	9907	99594	5	9957	99813	4
9608	98263	5	9658	98489	4	9708	98713	4	9758	98936	5	9808	99158	4	9858	99379	4	9908	99599	4	9958	99817	5
9609	98268	4	9659	98493	5	9709	98717	5	9759	98941	4	9809	99162	5	9859	99383	5	9909	99603	4	9959	99822	4
9610	98272	5	9660	98498	4	9710	98722	4	9760	98945	4	9810	99167	4	9860	99388	4	9910	99607	5	9960	99826	4
9611	98277	4	9661	98502	5	9711	98726	5	9761	98949	5	9811	99171	5	9861	99392	4	9911	99612	4	9961	99830	5
9612	98281	5	9662	98507	4	9712	98731	4	9762	98954	4	9812	99176	4	9862	99396	5	9912	99616	5	9962	99835	4
9613	98286	4	9663	98511	5	9713	98735	5	9763	98958	5	9813	99180	5	9863	99401	4	9913	99621	4	9963	99839	4
9614	98290	5	9664	98516	4	9714	98740	4	9764	98963	4	9814	99185	4	9864	99405	5	9914	99625	4	9964	99843	5
9615	98295	4	9665	98520	5	9715	98744	5	9765	98967	5	9815	99189	4	9865	99410	4	9915	99629	5	9965	99848	4
9616	98299	5	9666	98525	4	9716	98749	4	9766	98972	4	9816	99193	5	9866	99414	5	9916	99634	4	9966	99852	4
9617	98304	4	9667	98529	5	9717	98753	5	9767	98976	5	9817	99198	4	9867	99419	4	9917	99638	4	9967	99856	5
9618	98308	5	9668	98534	4	9718	98758	4	9768	98981	4	9818	99202	5	9868	99423	4	9918	99642	5	9968	99861	4
9619	98313	5	9669	98538	5	9719	98762	5	9769	98985	4	9819	99207	4	9869	99427	5	9919	99647	4	9969	99865	5
9620	98318	4	9670	98543	4	9720	98767	4	9770	98989	5	9820	99211	5	9870	99432	4	9920	99651	5	9970	99870	4
9621	98322	5	9671	98547	5	9721	98771	5	9771	98994	4	9821	99216	4	9871	99436	5	9921	99656	4	9971	99874	4
9622	98327	4	9672	98552	4	9722	98776	4	9772	98998	5	9822	99220	4	9872	99441	4	9922	99660	4	9972	99878	5
9623	98331	5	9673	98556	5	9723	98780	4	9773	99003	4	9823	99224	5	9873	99445	4	9923	99664	5	9973	99883	4
9624	98336	4	9674	98561	4	9724	98784	5	9774	99007	5	9824	99229	4	9874	99449	5	9924	99669	4	9974	99887	4
9625	98340	5	9675	98565	5	9725	98789	4	9775	99012	4	9825	99233	5	9875	99454	4	9925	99673	4	9975	99891	5
9626	98345	4	9676	98570	4	9726	98793	5	9776	99016	5	9826	99238	4	9876	99458	5	9926	99677	5	9976	99896	4
9627	98349	5	9677	98574	5	9727	98798	4	9777	99021	4	9827	99242	5	9877	99463	4	9927	99682	4	9977	99900	4
9628	98354	4	9678	98579	4	9728	98802	5	9778	99025	4	9828	99247	4	9878	99467	4	9928	99686	5	9978	99904	5
9629	98358	5	9679	98583	5	9729	98807	4	9779	99029	5	9829	99251	4	9879	99471	5	9929	99691	4	9979	99909	4
9630	98363	4	9680	98588	4	9730	98811	5	9780	99034	4	9830	99255	5	9880	99476	4	9930	99695	4	9980	99913	4
9631	98367	5	9681	98592	5	9731	98816	4	9781	99038	5	9831	99260	4	9881	99480	4	9931	99699	5	9981	99917	5
9632	98372	4	9682	98597	4	9732	98820	5	9782	99043	4	9832	99264	5	9882	99484	5	9932	99704	4	9982	99922	4
9633	98376	5	9683	98601	4	9733	98825	4	9783	99047	5	9833	99269	4	9883	99489	4	9933	99708	4	9983	99626	4
9634	98381	4	9684	98605	5	9734	98829	5	9784	99052	4	9834	99273	4	9884	99493	5	9934	99712	5	9984	99930	5
9635	98385	5	9685	98610	4	9735	98834	4	9785	99056	5	9835	99277	5	9885	99498	4	9935	99717	4	9985	99935	4
9636	98390	4	9686	98614	5	9736	98838	5	9786	99061	4	9836	99282	4	9886	99502	4	9936	99721	5	9986	99939	5
9637	98394	5	9687	98619	4	9737	98843	4	9787	99065	4	9837	99286	5	9887	99506	5	9937	99726	4	9987	99944	4
9638	98399	4	9688	98623	5	9738	98847	4	9788	99069	5	9838	99291	4	9888	99511	4	9938	99730	4	9988	99948	4
9639	98403	5	9689	98628	4	9739	98851	5	9789	99074	4	9839	99295	5	9889	99515	5	9939	99734	5	9989	99952	5
9640	98408	4	9690	98632	5	9740	98856	4	9790	99078	5	9840	99300	4	9890	99520	4	9940	99739	4	9990	99957	4
9641	98412	5	9691	98637	4	9741	98860	5	9791	99083	4	9841	99304	4	9891	99524	4	9941	99743	4	9991	99961	4
9642	98417	4	9692	98641	5	9742	98865	4	9792	99087	5	9842	99308	5	9892	99528	5	9942	99747	5	9992	99965	5
9643	98421	5	9693	98646	4	9743	98869	5	9793	99092	4	9843	99313	4	9893	99533	4	9943	99752	4	9993	99970	4
9644	98426	4	9694	98650	5	9744	98874	4	9794	99096	4	9844	99317	5	9894	99537	5	9944	99756	4	9994	99974	4
9645	98430	5	9695	98655	4	9745	98878	5	9795	99100	5	9845	99322	4	9895	99542	4	9945	99760	5	9995	99978	5
9646	98435	4	9696	98659	5	9746	98883	4	9796	99105	4	9846	99026	4	9896	99546	4	9946	99765	4	9996	99983	4
9647	98439	5	9697	98664	4	9747	98887	5	9797	99109	5	9847	99330	5	9897	99550	5	9947	99769	5	9997	99987	4
9648	98444	4	9698	98668	5	9748	98892	4	9798	99114	4	9848	99335	4	9898	99555	4	9948	99774	4	9998	99991	5
9649	98448	5	9699	98673	4	9749	98896	4	9799	99118	5	9849	99339	5	9899	99559	5	9949	99778	4	9999	99996	4
9650	98453		9700	98677		9750	98900		9800	99123		9850	99344		9900	99564		9950	99782		10000	00000	

0 Degrees.

′	Sin.	Dif.	Tang.	Dif.	Cot.	Cos.	′
0	*Inf. neg.*		*Inf. neg.*		*Inf. posit.*	0.00000	60
1	6.46373		6.46373		13.53627	0.00000	59
2	6.76476	30103	6.76476	30103	13.23524	0.00000	58
3	6.94085	17609	6.94085	17609	13.05915	0.00000	57
4	7.06579	12494	7.06579	12494	12.93421	0.00000	56
5	7.16270	9691	7.16270	9691	12.83730	0.00000	55
6	7.24188	7918	7.24188	7918	12.75812	0.00000	54
7	7.30882	6694	7.30882	6694	12.69118	0.00000	53
8	7.36682	5800	7.36682	5800	12.63318	0.00000	52
9	7.41797	5115	7.41797	5115	12.58203	0.00000	51
10	7.46373	4576	7.46373	4576	12.53627	0.00000	50
11	7.50512	4139	7.50512	4139	12.49488	0.00000	49
12	7.54291	3779	7.54291	3779	12.45709	0.00000	48
13	7.57767	3476	7.57767	3476	12.42233	0.00000	47
14	7.60985	3218	7.60986	3219	12.39014	0.00000	46
15	7.63982	2997	7.63982	2996	12.36018	0.00000	45
16	7.66784	2802	7.66785	2803	12.33215	0.00000	44
17	7.69417	2633	7.69418	2633	12.30582	9.99999	43
18	7.71900	2483	7.71900	2482	12.28100	9.99999	42
19	7.74248	2348	7.74248	2348	12.25752	9.99999	41
20	7.76475	2227	7.76476	2228	12.23524	9.99999	40
21	7.78594	2119	7.78595	2119	12.21405	9.99999	39
22	7.80615	2021	7.80615	2020	12.19385	9.99999	38
23	7.82545	1930	7.82546	1931	12.17454	9.99999	37
24	7.84393	1848	7.84394	1848	12.15606	9.99999	36
25	7.86166	1773	7.86167	1773	12.13833	9.99999	35
26	7.87870	1704	7.87871	1704	12.12129	9.99999	34
27	7.89509	1639	7.89510	1639	12.10490	9.99999	33
28	7.91088	1579	7.91089	1579	12.08911	9.99999	32
29	7.92612	1524	7.92613	1524	12.07387	9.99998	31
30	7.94084	1472	7.94086	1473	12.05914	9.99998	30
31	7.95508	1424	7.95510	1424	12.04490	9.99998	29
32	7.96887	1379	7.96889	1379	12.03111	9.99998	28
33	7.98223	1336	7.98225	1336	12.01775	9.99998	27
34	7.99520	1297	7.99522	1297	12.00478	9.99998	26
35	8.00779	1259	8.00781	1259	11.99219	9.99998	25
36	8.02002	1223	8.02004	1223	11.97996	9.99998	24
37	8.03192	1190	8.03194	1190	11.96806	9.99997	23
38	8.04350	1158	8.04353	1159	11.95647	9.99997	22
39	8.05478	1128	8.05481	1128	11.94519	9.99997	21
40	8.06578	1100	8.06581	1100	11.93419	9.99997	20
41	8.07650	1072	8.07653	1072	11.92347	9.99997	19
42	8.08696	1046	8.08700	1047	11.91300	9.99997	18
43	8.09718	1022	8.09722	1022	11.90278	9.99997	17
44	8.10717	999	8.10720	998	11.89280	9.99996	16
45	8.11693	976	8.11696	976	11.88304	9.99996	15
46	8.12647	954	8.12651	955	11.87349	9.99996	14
47	8.13581	934	8.13585	934	11.86415	9.99996	13
48	8.14495	914	8.14500	915	11.85500	9.99996	12
49	8.15391	896	8.15395	895	11.84605	9.99996	11
50	8.16268	877	8.16273	878	11.83727	9.99995	10
51	8.17128	860	8.17133	860	11.82867	9.99995	9
52	8.17971	843	8.17976	843	11.82024	9.99995	8
53	8.18798	827	8.18804	828	11.81196	9.99995	7
54	8.19610	812	8.19616	812	11.80383	9.99995	6
55	8.20407	797	8.20413	797	11.79587	9.99994	5
56	8.21189	782	8.21195	782	11.78805	9.99994	4
57	8.21958	769	8.21964	769	11.78036	9.99994	3
58	8.22713	755	8.22720	756	11.77280	9.99994	2
59	8.23456	743	8.23462	742	11.76538	9.99994	1
60	8.24186	730	8.24192	730	11.75808	9.99993	0
	Cos.		Cot.		Tang.	Sin.	

89 Degrees.

1 Degree.

′	Sin.	Dif.	Tang.	Dif.	Cot.	Cos.	′
0	8.24186		8.24192		11.75808	9.99993	60
1	8.24903	717	8.24910	718	11.75090	9.99993	59
2	8.25609	706	8.25616	706	11.74383	9.99993	58
3	8.26304	695	8.26312	696	11.73688	9.99993	57
4	8.26988	684	8.26996	684	11.73004	9.99992	56
5	8.27661	673	8.27669	673	11.72331	9.99992	55
6	8.28324	663	8.28332	663	11.71668	9.99992	54
7	8.28977	653	8.28986	654	11.71014	9.99992	53
8	8.29621	644	8.29629	643	11.70371	9.99992	52
9	8.30255	634	8.30263	634	11.69737	9.99991	51
10	8.30879	624	8.30888	625	11.69112	9.99991	50
11	8.31495	616	8.31505	617	11.68495	9.99991	49
12	8.32103	608	8.32112	607	11.67888	9.99990	48
13	8.32702	599	8.32711	599	11.67289	9.99990	47
14	8.33292	590	8.33302	591	11.66698	9.99990	46
15	8.33875	583	8.33886	584	11.66114	9.99990	45
16	8.34450	575	8.34461	575	11.65539	9.99989	44
17	8.35018	568	8.35029	568	11.64971	9.99989	43
18	8.35578	560	8.35590	561	11.64410	9.99989	42
19	8.36131	553	8.36143	553	11.63857	9.99989	41
20	8.36678	547	8.36689	546	11.63311	9.99988	40
21	8.37217	539	8.37229	540	11.62771	9.99988	39
22	8.37750	533	8.37762	533	11.62238	9.99988	38
23	8.38276	526	8.38289	527	11.61711	9.99987	37
24	8.38796	520	8.38809	520	11.61191	9.99987	36
25	8.39310	514	8.39323	514	11.60677	9.99987	35
26	8.39818	508	8.39832	509	11.60168	9.99986	34
27	8.40320	502	8.40334	502	11.59666	9.99986	33
28	8.40816	496	8.40830	496	11.59170	9.99986	32
29	8.41307	491	8.41321	491	11.58679	9.99985	31
30	8.41792	485	8.41807	486	11.58193	9.99985	30
31	8.42272	480	8.42287	480	11.57713	9.99985	29
32	8.42746	474	8.42762	475	11.57238	9.99984	28
33	8.43216	470	8.43232	470	11.56768	9.99984	27
34	8.43680	464	8.43696	464	11.56304	9.99984	26
35	8.44139	459	8.44156	460	11.55844	9.99983	25
36	8.44594	455	8.44611	455	11.55389	9.99983	24
37	8.45044	450	8.45061	450	11.54939	9.99983	23
38	8.45489	445	8.45507	446	11.54493	9.99982	22
39	8.45930	441	8.45948	441	11.54052	9.99982	21
40	8.46366	436	8.46385	437	11.53615	9.99982	20
41	8.46799	433	8.46817	432	11.53183	9.99981	19
42	8.47226	427	8.47245	428	11.52755	9.99981	18
43	8.47650	424	8.47669	424	11.52331	9.99981	17
44	8.48069	419	8.48089	420	11.51911	9.99980	16
45	8.48485	416	8.48505	416	11.51495	9.99980	15
46	8.48896	411	8.48917	412	11.51083	9.99979	14
47	8.49304	408	8.49325	408	11.50675	9.99979	13
48	8.49708	404	8.49729	404	11.50271	9.99979	12
49	8.50108	400	8.50130	401	11.49870	9.99978	11
50	8.50504	396	8.50527	397	11.49473	9.99978	10
51	8.50897	393	8.50920	393	11.49080	9.99977	9
52	8.51287	390	8.51310	390	11.48690	9.99977	8
53	8.51673	386	8.51696	386	11.48304	9.99977	7
54	8.52055	382	8.52079	383	11.47921	9.99976	6
55	8.52434	379	8.52459	380	11.47541	9.99976	5
56	8.52810	376	8.52835	376	11.47165	9.99975	4
57	8.53183	373	8.53208	373	11.46792	9.99975	3
58	8.53552	369	8.53578	370	11.46422	9.99974	2
59	8.53919	367	8.53945	367	11.46055	9.99974	1
60	8.54282	363	8.54308	363	11.45692	9.99974	0
	Cos.		Cot.		Tang.	Sin.	

88 Degrees.

2 Degrees.							
′	Sin.	Dif.	Tang.	Dif.	Cot.	Cos.	′
0	8.54282	360	8.54308	361	11.45692	9.99974	60
1	8.54642	357	8.54669	358	11.45331	9.99973	59
2	8.54999	355	8.55027	355	11.44973	9.99973	58
3	8.55354	351	8.55382	352	11.44618	9.99972	57
4	8.55705	349	8.55734	349	11.44266	9.99972	56
5	8.56054	346	8.56083	346	11.43917	9.99971	55
6	8.56400	343	8.56429	344	11.43571	9.99971	54
7	8.56743	341	3.56773	341	11.43227	9.99970	53
8	3.57084	337	8.57114	338	11.42886	9.99970	52
9	8.57421	336	8.57452	336	11.42548	9.99969	51
10	8.57757	332	8.57788	333	11.42212	9.99969	50
11	8.58089	330	8.58121	330	11.41879	9.99968	49
12	8.58419	328	8.58451	328	11.41549	9.99968	48
13	8.58747	325	8.58779	326	11.41221	9.99967	47
14	8.59072	323	8.59105	323	11.40895	9.99967	46
15	8.59395	320	8.59428	321	11.40572	9.99967	45
16	8.59715	318	8.59749	319	11.40251	9.99966	44
17	8.60033	316	8.60068	316	11.39932	9.99966	43
18	8.60349	313	8.60384	314	11.39616	9.99965	42
19	8.60662	311	8.60698	311	11.39302	9.99964	41
20	8.60973	309	8.61009	310	11.38991	9.99964	40
21	8.61282	307	8.61319	307	11.38681	9.99963	39
22	8.61589	305	8.61626	305	11.38374	9.99963	38
23	8.61894	302	8.61931	303	11.38069	9.99962	37
24	8.62196	301	8.62234	301	11.37766	9.99962	36
25	8.62497	298	8.62535	299	11.37465	9.99961	35
26	8.62795	296	8.62834	297	11.37166	9.99961	34
27	8.63091	294	8.63131	295	11.36869	9.99960	33
28	8.63385	293	8.63426	292	11.36574	9.99960	32
29	8.63678	290	8.63718	291	11.36282	9.99959	31
30	8.63968	288	8.64009	289	11.35991	9.99959	30
31	8.64256	287	8.64298	287	11.35702	9.99958	29
32	8.64543	284	8.64585	285	11.35415	9.99958	28
33	8.64827	283	8.64870	284	11.35130	9.99957	27
34	8.65110	281	8.65154	281	11.34846	9.99956	26
35	8.65391	279	8.65435	280	11.34565	9.99956	25
36	8.65670	277	8.65715	278	11.34285	9.99955	24
37	8.65947	276	8.65993	276	11.34007	9.99955	23
38	8.66223	274	8.66269	274	11.33731	9.99954	22
39	8.66497	272	8.66543	273	11.33457	9.99954	21
40	8.66769	270	8.66816	271	11.33184	9.99953	20
41	8.67039	269	8.67087	269	11.32913	9.99952	19
42	8.67308	267	8.67356	268	11.32644	9.99952	18
43	8.67575	266	8.67624	266	11.32376	9.99951	17
44	8.67841	263	8.67890	264	11.32110	9.99951	16
45	8.68104	263	8.68154	263	11.31846	9.99950	15
46	8.68367	260	8.68417	261	11.31583	9.99949	14
47	8.68627	259	8.68678	260	11.31322	9.99949	13
48	8.68886	258	8.68938	258	11.31062	9.99948	12
49	8.69144	256	8.69196	257	11.30804	9.99948	11
50	8.69400	254	8.69453	255	11.30547	9.99947	10
51	8.69654	253	8.69708	254	11.30292	9.99946	9
52	8.69907	252	8.69962	252	11.30038	9.99946	8
53	8.70159	250	8.70214	251	11.29786	9.99945	7
54	8.70409	249	8.70465	249	11.29535	9.99944	6
55	8.70658	247	8.70714	248	11.29286	9.99944	5
56	8.70905	246	8.70962	246	11.29038	9.99943	4
57	8.71151	244	8.71208	245	11.28792	9.99942	3
58	8.71395	243	8.71453	244	11.28547	9.99942	2
59	8.71638	242	8.71697	243	11.28303	9.99941	1
60	8.71880		8.71940		11.28060	9.99940	0
	Cos.		Cot.		Tang.	Sin.	
87 Degrees.							

3 Degrees.							
′	Sin.	Dif.	Tang.	Dif.	Cot.	Cos.	′
0	8.71880	240	8.71940	241	11.28060	9.99940	60
1	8.72120	239	8.72181	239	11.27819	9.99940	59
2	8.72359	238	8.72420	239	11.27580	9.99939	58
3	8.72597	237	8.72659	237	11.27341	9.99938	57
4	8.72834	235	8.72896	236	11.27104	9.99938	56
5	8.73069	234	8.73132	234	11.26868	9.99937	55
6	8.73303	232	8.73366	234	11.26634	9.99936	54
7	8.73535	232	8.73600	232	11.26400	9.99936	53
8	8.73767	230	8.73832	231	11.26168	9.99935	52
6	8.73997	229	8.74063	229	11.25937	9.99934	51
10	8.74226	228	8.74292	229	11.25708	9.99934	50
11	8.74454	226	8.74521	227	11.25479	9.99933	49
12	8.74680	226	8.74748	226	11.25252	9.99932	48
13	8.74906	224	8.74974	225	11.25026	9.99932	47
14	8.75130	223	8.75199	224	11.24801	9.99931	46
15	8.75353	222	8.75423	222	11.24577	9.99930	45
16	8.75575	220	8.75645	222	11.24355	9.99929	44
17	8.75795	220	8.75867	220	11.24133	9.99929	43
18	8.76015	219	8.76087	219	11.23913	9.99928	42
19	8.76234	217	8.76306	219	11.23694	9.99927	41
20	8.76451	216	8.76525	217	11.23475	9.99926	40
21	8.76667	216	8.76742	216	11.23258	9.99926	39
22	8.76883	214	8.76958	215	11.23042	9.99925	38
23	8.77097	213	8.77173	214	11.22827	9.99924	37
24	8.77310	212	8.77387	213	11.22613	9.99923	36
25	8.77522	211	8.77600	211	11.22400	9.99923	35
26	8.77733	210	8.77811	211	11.22189	9.99922	34
27	8.77943	209	8.78022	210	11.21978	9.99921	33
28	8.78152	208	8.78232	209	11.21768	9.99920	32
29	8.78360	208	8.78441	208	11.21559	9.99920	31
30	8.78568	206	8.78649	206	11.21351	9.99919	30
31	8.78774	205	8.78855	206	11.21145	9.99918	29
32	8.78979	204	8.79061	205	11.20939	9.99917	28
33	8.79183	203	8.79266	204	11.20734	9.99917	27
34	8.79386	202	8.79470	203	11.20530	9.99916	26
35	8.79588	201	8.79673	202	11.20327	9.99915	25
36	8.79789	201	8.79875	201	11.20125	9.99914	24
37	8.79990	199	8.80076	201	11.19924	9.99913	22
38	8.80189	199	8.80277	199	11.19723	9.99913	22
39	8.80388	197	8.80476	198	11.19524	9.99912	21
40	8.80585	197	8.80674	198	11.19326	9.99911	20
41	8.80782	199	8.80872	196	11.19128	9.99910	19
42	8.80978	195	8.81068	196	11.18932	9.99909	18
43	8.81173	194	8.81264	195	11.18736	9.99909	17
44	8.81367	193	8.81459	194	11.18541	9.99908	16
45	8.81560	192	8.81653	193	11.18347	9.99907	15
46	8.81752	192	8.81846	192	11.18154	9.99906	14
47	8.81944	190	8.82038	192	11.17962	9.99905	13
48	8.82134	190	8.82230	190	11.17770	9.99904	12
49	8.82324	189	8.82420	190	11.17580	9.99904	11
50	8.82513	188	8.82610	189	11.17390	9.99903	10
51	8.82701	187	8.82799	188	11.17201	9.99902	9
52	8.82888	187	8.82987	188	11.17013	9.99901	8
53	8.83075	186	8.83175	186	11.16825	9.99900	7
54	8.83261	185	8.83361	186	11.16639	9.99899	6
55	8.83446	184	8.83547	185	11.16453	9.99898	5
56	8.83630	183	8.83732	184	11.16268	9.99898	4
57	8.83813	183	8.83916	184	11.16084	9.99897	3
58	8.83996	181	8.84100	182	11.15900	9.99896	2
59	8.84177	181	8.84282	182	11.15718	9.99895	1
60	8.84358		8.84464		11.15536	9.99894	0
	Cos.		Cot.		Tang.	Sin.	
86 Degrees.							

4 Degrees.							
'	Sin.	Dif.	Tang.	Dif.	Cot.	Cos.	'
0	8.84358	181	8.84464	182	11.15536	9.99894	60
1	8.84539	179	8.84646	180	11.15354	9.99893	59
2	8.84718	179	8.84826	180	11.15174	9.99892	58
3	8.84897	178	8.85006	179	11.14994	9.99891	57
4	8.85075	177	8.85185	178	11.14815	9.99891	56
5	8.85252	177	8.85363	177	11.14637	9.99890	55
6	8.85429	176	8.85540	177	11.14460	9.99889	54
7	8.85605	175	8.85717	176	11.14283	9.99888	53
8	8.85780	175	8.85893	176	11.14107	9.99887	52
9	8.85955	173	8.86069	174	11.13931	9.99886	51
10	8.86128	173	8.86243	174	11.13757	9.99885	50
11	8.86301	173	8.86417	174	11.13583	9.99884	49
12	8.86474	171	8.86591	172	11.13409	9.99883	48
13	8.86645	171	8.86763	172	11.13237	9.99882	47
14	8.86816	171	8.86935	171	11.13065	9.99881	46
15	8.86987	169	8.87106	171	11.12894	9.99880	45
16	8.87156	169	8.87277	170	11.12723	9.99879	44
17	8.87325	169	8.87447	169	11.12553	9.99879	43
18	8.87494	167	8.87616	169	11.12384	9.99878	42
19	8.87661	168	8.87785	168	11.12215	9.99877	41
20	8.87829	166	8.87953	167	11.12047	9.99876	40
21	8.87995	166	8.88120	167	11.11880	9.99875	39
22	8.88161	165	8.88287	166	11.11713	9.99874	38
23	8.88326	164	8.88453	165	11.11547	9.99873	37
24	8.88490	164	8.88618	165	11.11382	9.99872	36
25	8.88654	163	8.88783	165	11.11217	9.99871	35
26	8.88817	163	8.88948	163	11.11052	9.99870	34
27	8.88980	162	8.89111	163	11.10889	9.99869	33
28	8.89142	162	8.89274	163	11.10726	9.99868	32
29	8.89304	160	8.89437	161	11.10563	9.99867	31
30	8.89464	161	8.89598	162	11.10402	9.99866	30
31	8.89625	159	8.89760	160	11.10240	9.99865	29
32	8.89784	159	8.89920	160	11.10080	9.99864	28
33	8.89943	159	8.90080	160	11.09920	9.99863	27
34	8.90102	158	8.90240	159	11.09760	9.99862	26
35	8.90260	157	8.90399	158	11.09601	9.99861	25
36	8.90417	157	8.90557	158	11.09443	9.99860	24
37	8.90574	156	8.90715	157	11.09285	9.99859	23
38	8.90730	155	8.90872	157	11.09128	9.99858	22
39	8.90885	155	8.91029	156	11.08971	9.99857	21
40	8.91040	155	8.91185	155	11.08815	9.99856	20
41	8.91195	154	8.91340	155	11.08660	9.99855	19
42	8.91349	153	8.91495	155	11.08505	9.99854	18
43	8.91502	153	8.91650	153	11.08350	9.99853	17
44	8.91655	152	8.91803	154	11.08197	9.99852	16
45	8.91807	152	8.91957	153	11.08043	9.99851	15
46	8.91959	151	8.92110	152	11.07890	9.99850	14
47	8.92110	151	8.92262	152	11.07738	9.99848	13
48	8.92261	150	8.92414	151	11.07586	9.99847	12
49	8.92411	150	8.92565	151	11.07435	9.99846	11
50	8.92561	149	8.92716	150	11.07284	9.99845	10
51	8.92710	149	8.92866	150	11.07134	9.99844	9
52	8.92859	148	8.93016	149	11.06984	9.99843	8
53	8.93007	147	8.93165	148	11.06835	9.99842	7
54	8.93154	147	8.93313	149	11.06687	9.99841	6
55	8.93301	147	8.93462	147	11.06538	9.99840	5
56	8.93448	146	8.93609	147	11.06391	9.99839	4
57	8.93594	146	8.93756	147	11.06244	9.99838	3
58	8.93740	145	8.93903	146	11.06097	9.99837	2
59	8.93885	145	8.94049	146	11.05951	9.99836	1
60	8.94030		8.94195		11.05805	9.99834	0
	Cos.		Cot.		Tang.	Sin.	
85 Degrees.							

5 Degrees.							
'	Sin.	Dif.	Tang.	Dif.	Cot.	Cos.	'
0	8.94030	144	8.94195	145	11.05805	9.99834	60
1	8.94174	143	8.94340	145	11.05660	9.99833	59
2	8.94317	144	8.94485	145	11.05515	9.99832	58
3	8.94461	142	8.94630	143	11.05370	9.99831	57
4	8.94603	143	8.94773	144	11.05227	9.99830	56
5	8.94746	141	8.94917	143	11.05083	9.99829	55
6	8.94887	142	8.95060	142	11.04940	9.99828	54
7	8.95029	141	8.95202	142	11.04798	9.99827	53
8	8.95170	140	8.95344	142	11.04656	9.99825	52
9	8.95310	140	8.95486	141	11.04514	9.99824	51
10	8.95450	139	8.95627	140	11.04373	9.99823	50
11	8.95589	139	8.95767	141	11.04233	9.99822	49
12	8.95728	139	8.95908	139	11.04092	9.99821	48
13	8.95867	138	8.96047	140	11.03953	9.99820	47
14	8.96005	138	8.96187	138	11.03813	9.99819	46
15	8.96143	137	8.96325	139	11.03675	9.99817	45
16	8.96280	137	8.96464	138	11.03536	9.99816	44
17	8.96417	136	8.96602	137	11.03398	9.99815	43
18	8.96553	136	8.96739	138	11.03261	9.99814	42
19	8.96689	136	8.96877	136	11.03123	9.99813	41
20	8.96825	135	8.97013	137	11.02987	9.99812	40
21	8.96960	135	8.97150	135	11.02850	9.99810	39
22	8.97095	134	8.97285	136	11.02715	9.99809	38
23	8.97229	134	8.97421	135	11.02579	9.99808	37
24	8.97363	133	8.97556	135	11.02444	9.99807	36
25	8.97496	133	8.97691	134	11.02309	9.99806	35
26	8.97629	133	8.97825	134	11.02175	9.99804	34
27	8.97762	132	8.97959	133	11.02041	9.99803	33
28	8.97894	132	8.98092	133	11.01908	9.99802	32
29	8.98026	131	8.98225	133	11.01775	9.99801	31
30	8.98157	131	8.98358	132	11.01642	9.99800	30
31	8.98288	131	8.98490	132	11.01510	9.99798	29
32	8.98419	130	8.98622	131	11.01378	9.99797	28
33	8.98549	130	8.98753	131	11.01247	9.99796	27
34	8.98679	129	8.98884	131	11.01116	9.99795	26
35	8.98808	129	8.99015	130	11.00985	9.99793	25
36	8.98937	129	8.99145	130	11.00855	9.99792	24
37	8.99066	128	8.99275	130	11.00725	9.99791	23
38	8.99194	128	8.99405	129	11.00595	9.99790	22
39	8.99322	128	8.99534	128	11.00466	9.99788	21
40	8.99450	127	8.99662	129	11.00338	9.99787	20
41	8.99577	127	8.99791	128	11.00209	9.99786	19
42	8.99704	126	8.99919	127	11.00081	9.99785	18
43	8.99830	126	9.00046	128	10.99954	9.99783	17
44	8.99956	126	9.00174	127	10.99826	9.99782	16
45	9.00082	125	9.00301	126	10.99699	9.99781	15
46	9.00207	125	9.00427	126	10.99573	9.99780	14
47	9.00332	124	9.00553	126	10.99447	9.99778	13
48	9.00456	125	9.00679	126	10.99321	9.99777	12
49	9.00581	123	9.00805	125	10.99195	9.99776	11
50	9.00704	124	9.00930	125	10.99070	9.99775	10
51	9.00828	123	9.01055	124	10.98945	9.99773	9
52	9.00951	123	9.01179	124	10.98821	9.99772	8
53	9.01074	122	9.01303	124	10.98697	9.99771	7
54	9.01196	122	9.01427	123	10.98573	9.99769	6
55	9.01318	122	9.01550	123	10.98450	9.99768	5
56	9.01440	121	9.01673	123	10.98327	9.99767	4
57	9.01561	121	9.01796	122	10.98204	9.99765	3
58	9.01682	121	9.01918	122	10.98082	9.99764	2
59	9.01803	120	9.02040	122	10.97960	9.99763	1
60	9.01923		9.02162		10.97838	9.99761	0
	Cos.		Cot.		Tang.	Sin.	
84 Degrees.							

6 Degrees.

′	Sin.	Dif.	Tang.	Dif.	Cot.	Cof.	′
0	9.01923	120	9.02162	121	10.97838	9.99761	60
1	9.02043	120	9.02283	121	10.97717	9.99760	59
2	9.02163	120	9.02404	121	10.97596	9.99759	58
3	9.02283	119	9.02525	120	10.97475	9.99757	57
4	9.02402	118	9.02645	121	10.97355	9.99756	56
5	9.01520	119	9.02766	119	10.97234	9.99755	55
6	9.02639	118	9.02885	120	10.97115	9.99753	54
7	9.02757	117	9.03005	119	10.96995	9.99752	53
8	9.02874	118	9.03124	118	10.96876	9.99751	52
9	9.02992	117	9.03242	119	10.96758	9.99749	51
10	9.03109	117	9.03361	118	10.96639	9.99748	50
11	9.03226	116	9.03479	118	10.96521	9.99747	49
12	9.03342	116	9.03597	117	10.96403	9.99745	48
13	9.03458	116	9.03714	118	10.96286	9.99744	47
14	9.03574	116	9.03832	116	10.96168	9.99742	46
15	9.03690	115	9.03948	117	10.96052	9.99741	45
16	9.03805	115	9.04065	116	10.95935	9.99740	44
17	9.03920	114	9.04181	116	10.95819	9.99738	43
18	9.04034	115	9.04297	116	10.95703	9.99737	42
19	9.04149	113	9.04413	115	10.95587	9.99736	41
20	9.04262	114	9.04528	115	10.95472	9.99734	40
21	9.04376	114	9.04643	115	10.95357	9.99733	39
22	9.04490	113	9.04758	115	10.95242	9.99731	38
23	9.04603	112	9.04873	114	10.95127	9.99730	37
24	9.04715	113	9.04987	114	10.95013	9.99728	36
25	9.04828	112	9.05101	113	10.94899	9.99727	35
26	9.04940	112	9.05214	114	10.94786	9.99726	34
27	9.05052	112	9.05328	113	10.94672	9.99724	33
28	9.05164	111	9.05441	112	10.94559	9.99723	32
29	9.05275	111	9.05553	113	10.94447	9.99721	31
30	9.05386	111	9.05666	112	10.94334	9.99720	30
31	9.05497	110	9.05778	112	10.94222	9.99718	29
32	9.05607	110	9.05890	112	10.94110	9.99717	28
33	9.05717	110	9.06002	111	10.93998	9.99716	27
34	9.05827	110	9.06113	111	10.93887	9.99714	26
35	9.05937	109	9.06224	111	10.93776	9.99713	25
36	9.06046	109	9.06335	110	10.93665	9.99711	24
37	9.06155	109	9.06445	111	10.93555	9.99710	23
38	9.06264	108	9.06556	110	10.93444	9.99708	22
39	9.06372	109	9.06666	109	10.93334	9.99707	21
40	9.06481	108	9.06775	110	10.93225	9.99705	20
41	9.06589	107	9.06885	109	10.93115	9.99704	19
42	9.06696	108	9.06994	109	10.93006	9.99702	18
43	9.06804	107	9.07103	108	10.92897	9.99701	17
44	9.06911	107	9.07211	109	10.92789	9.99699	16
45	9.07018	106	9.07320	108	10.92680	9.99698	15
46	9.07124	107	9.07428	108	10.92572	9.99696	14
47	9.07231	106	9.07536	107	10.92464	9.99695	13
48	9.07337	105	9.07643	108	10.92357	9.99693	12
49	9.07442	106	9.07751	107	10.92249	9.99692	11
50	9.07548	105	9.07858	106	10.92142	9.99690	10
51	9.07653	105	9.07964	107	10.92036	9.99689	9
52	9.07758	105	9.08071	106	10.91929	9.99687	8
53	9.07863	105	9.08177	106	10.91823	9.99686	7
54	9.07968	104	9.08283	106	10.91717	9.99684	6
55	9.08072	104	9.08389	106	10.91611	9.99683	5
56	9.08176	104	9.08495	105	10.91505	9.99681	4
57	9.08280	103	9.08600	105	10.91400	9.99680	3
58	9.08383	103	9.08705	105	10.91295	9.99678	2
59	9.08486	103	9.08810	104	10.91190	9.99677	1
60	9.08589		9.08914		10.91086	9.99675	0
	Cof.		Cot.		Tang.	Sin.	

83 Degrees.

7 Degrees.

′	Sin.	Dif.	Tang.	Dif.	Cot.	Cof.	′
0	9.08589	103	9.08914	105	10.91086	9.99675	60
1	9.08692	103	9.09019	104	10.90981	9.99674	59
2	9.08795	102	9.09123	104	10.90877	9.99672	58
3	9.08897	102	9.09227	103	10.90773	9.99670	57
4	9.08999	102	9.09330	104	10.90670	9.99669	56
5	9.09101	101	9.09434	103	10.90566	9.99667	55
6	9.09202	102	9.09537	103	10.90463	9.99666	54
7	9.09304	101	9.09640	102	10.90360	9.99664	53
8	9.09405	101	9.09742	103	10.90258	9.99663	52
9	9.09506	100	9.09845	102	10.90155	9.99661	51
10	9.09606	101	9.09947	102	10.90053	9.99659	50
11	9.09707	100	9.10049	101	10.89951	9.99658	49
12	9.09807	100	9.10150	102	10.89850	9.99656	48
13	9.09907	99	9.10252	101	10.89748	9.99655	47
14	9.10006	100	9.10353	101	10.89647	9.99653	46
15	9.10106	99	9.10454	101	10.89546	9.99651	45
16	9.10205	99	9.10555	101	10.89445	9.99650	44
17	9.10304	98	9.10656	100	10.89344	9.99648	43
18	9.10402	99	9.10756	100	10.89244	9.99647	42
19	9.10501	98	9.10856	100	10.89144	9.99645	41
20	9.10599	98	9.10956	100	10.89044	9.99643	40
21	9.10697	98	9.11056	99	10.88944	9.99642	39
22	9.10795	98	9.11155	99	10.88845	9.99640	38
23	9.10893	97	9.11254	99	10.88746	9.99638	37
24	9.10990	97	9.11353	99	10.88647	9.99637	36
25	9.11087	97	9.11452	99	10.88548	9.99635	35
26	9.11184	97	9.11551	98	10.88449	9.99633	34
27	9.11281	96	9.11649	98	10.88351	9.99632	33
28	9.11377	97	9.11747	98	10.88253	9.99630	32
29	9.11474	96	9.11845	98	10.88155	9.99629	31
30	9.11570	96	9.11943	97	10.88057	9.99627	30
31	9.11666	95	9.12040	98	10.87960	9.99625	29
32	9.11761	96	9.12138	97	10.87862	9.99624	28
33	9.11857	95	9.12235	97	10.87765	9.99622	27
34	9.11952	95	9.12332	96	10.87668	9.99620	26
35	9.12047	95	9.12428	97	10.87572	9.99618	25
36	9.12142	94	9.12525	96	10.87475	9.99617	24
37	9.12236	95	9.12621	96	10.87379	9.99615	23
38	9.12331	94	9.12717	96	10.87283	9.99613	22
39	9.12425	94	9.12813	96	10.87187	9.99612	21
40	9.12519	93	9.12909	95	10.87091	9.99610	20
41	9.12612	94	9.13004	95	10.86996	9.99608	19
42	9.12706	93	9.13099	95	10.86901	9.99607	18
43	9.12799	93	9.13194	95	10.86806	9.99605	17
44	9.12892	93	9.13289	95	10.86711	9.99603	16
45	9.12985	93	9.13384	94	10.86616	9.99601	15
46	9.13078	93	9.13478	95	10.86522	9.99600	14
47	9.13171	92	9.13573	94	10.86427	9.99598	13
48	9.13263	92	9.13667	94	10.86333	9.99596	12
49	9.13355	92	9.13761	93	10.86239	9.99595	11
50	9.13447	92	9.13854	94	10.86146	9.99593	10
51	9.13539	91	9.13948	93	10.86052	9.99591	9
52	9.13630	92	9.14041	93	10.85956	9.99589	8
53	9.13722	91	9.14134	93	10.85866	9.99588	7
54	9.13813	91	9.14227	93	10.85773	9.99586	6
55	9.13904	90	9.14320	92	10.85680	9.99584	5
56	9.13994	91	9.14412	92	10.85588	9.99582	4
57	9.14085	90	9.14504	93	10.85496	9.99581	3
58	9.14175	91	9.14597	91	10.85403	9.99579	2
59	9.14266	90	9.14688	92	10.85312	9.99577	1
60	9.14356		9.14780		10.85220	9.99575	0
	Cof.		Cot.		Tang.	Sin.	

82 Degrees.

8 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	′
0	9.14356	89	9.14780	92	10.85220	9.99575	60
1	9.14445	90	9.14872	91	10.85128	9.99574	59
2	9.14535	89	9.14963	91	10.85037	9.99572	58
3	9.14624	90	9.15054	91	10.84946	9.99570	57
4	9.14714	89	9.15145	91	10.84855	9.99568	56
5	9.14803	88	9.15236	91	10.84764	9.99566	55
6	9.14891	89	9.15327	90	19.84673	9.99565	54
7	9.14980	89	9.15417	91	10.84583	9.99563	53
8	9.15069	88	9.15508	90	10.84492	9.99561	52
9	9.15157	88	9.15598	90	10.84402	9.99559	51
10	9.15245	88	9.15688	89	10.84312	9.99557	50
11	9.15333	88	9.15777	90	10.84223	9.99556	49
12	9.15421	87	9.15867	89	10.84133	9.99554	48
13	9.15508	88	9.15956	90	10.84044	9.99552	47
14	9.15596	87	9.16046	89	10.83954	9.99550	46
15	9.15683	87	9.16135	89	10.83865	9.99548	45
16	9.15770	87	9.16224	88	10.83776	9.99546	44
17	9.15857	87	9.16312	89	10.83688	9.99545	43
18	9.15944	86	9.16401	88	10.83599	9.99543	42
19	9.16030	86	9.16489	88	10.83511	9.99541	41
20	9.16116	87	9.16577	88	10.83423	9.99539	40
21	9.16203	86	9.16665	88	10.83335	9.99537	39
22	9.16289	85	9.16753	88	10.83247	9.99535	38
23	9.16374	86	9.16841	87	10.83159	9.99533	37
24	9.16460	85	9.16928	88	10.83072	9.99532	36
25	9.16545	86	9.17016	87	10.82984	9.99530	35
26	9.16631	85	9.17103	87	10.82897	9.99528	34
27	9.16716	85	9.17190	87	10.82810	9.99526	33
28	9.16801	85	9.17277	86	10.82723	9.99524	32
29	9.16886	84	9.17363	87	10.82637	9.99522	31
30	9.16970	85	9.17450	86	10.82550	9.99520	30
31	9.17055	84	9.17536	86	10.82464	9.99518	29
32	9.17139	84	9.17622	86	10.82378	9.99517	28
33	9.17223	84	9.17708	86	10.82292	9.99515	27
34	9.17307	84	9.17794	86	10.82206	9.99513	26
35	9.17391	83	9.17880	85	10.82120	9.99511	25
36	9.17474	84	9.17965	86	10.82035	9.99509	24
37	9.17558	83	9.18051	85	10.81949	9.99507	23
38	9.17641	83	9.18136	85	10.81864	9.99505	22
39	9.17724	83	9.18221	85	10.81779	9.99503	21
40	9.17807	83	9.18306	85	10.81694	9.99501	20
41	9.17890	83	9.18391	84	10.81609	9.99499	19
42	9.17973	82	9.18475	85	10.81525	9.99497	18
43	9.18055	82	9.18560	84	10.81440	9.99495	17
44	9.18137	83	9.18644	84	10.81356	9.99494	16
45	9.18220	82	9.18728	84	10.81272	9.99492	15
46	9.18302	81	9.18812	84	10.81188	9.99490	14
47	9.18383	82	9.18896	83	10.81104	9.99488	13
48	9.18465	82	9.18979	84	10.81021	9.99486	12
49	9.18547	81	9.19063	83	10.80937	9.99484	11
50	9.18628	81	9.19146	83	10.80854	9.99482	10
51	9.18709	81	9.19229	83	10.80771	9.99480	9
52	9.18790	81	9.19312	83	10.80688	9.99478	8
53	9.18871	81	9.19395	83	10.80605	9.99476	7
54	9.18952	81	9.19478	83	10.80522	9.99474	6
55	9.19033	80	9.19561	82	10.80439	9.99472	5
56	9.19113	80	9.19643	82	10.80357	9.99470	4
57	9.19193	80	9.19725	82	10.80275	9.99468	3
58	9.19273	80	9.19807	82	10.80193	9.99466	2
59	9.19353	80	9.19889	82	10.80111	9.99464	1
60	9.19433		9.19971		10.80029	9.99462	0
	Cof.		Cot.		Tang.	Sin.	

81 Degrees.

9 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	′
0	9.19433	80	9.19971	82	10.80029	9.99462	60
1	9.19513	79	9.20053	81	10.79947	9.99460	59
2	9.19592	80	9.20134	82	10.79866	9.99458	58
3	9.19672	79	9.20216	81	10.79784	9.99456	57
4	9.19751	79	9.20297	81	10.79703	9.99354	56
5	9.19830	79	9.20378	81	10.79622	9.99452	55
6	9.19909	79	9.20459	81	10.79541	9.99450	54
7	9.19988	79	9.20540	81	10.79460	9.99448	53
8	9.20067	78	9.20621	80	10.79379	9.99446	52
9	9.20145	78	9.20701	81	10.79299	9.99444	51
10	9.20223	79	9.20782	80	10.79218	9.99442	50
11	9.20302	78	9.20862	80	10.79138	9.99440	49
12	9.20380	78	9.20942	80	10.79058	9.99438	48
13	9.20458	77	9.21022	80	10.78978	9.99436	47
14	9.20535	78	9.21102	80	10.78898	9.99434	46
15	9.20613	78	9.21182	79	10.78818	9.99432	45
16	9.20691	77	9.21261	80	10.78739	9.99429	44
17	9.20768	77	9.21341	79	10.78659	9.99427	43
18	9.20845	77	9.21420	79	10.78580	9.99425	42
19	9.20922	77	9.21499	79	10.78501	9.99423	41
20	9.20999	77	9.21578	79	10.78422	9.99421	40
21	9.21076	77	9.21657	79	10.78343	9.99419	39
22	9.21153	76	9.21736	78	10.78264	9.99417	38
23	9.21229	77	9.21814	79	10.78186	9.99415	37
24	9.21306	76	9.21893	78	10.78107	9.99413	36
25	9.21382	76	9.21971	78	10.78029	9.99411	35
26	9.21458	76	9.22049	78	10.77951	9.99409	34
27	9.21534	76	9.22127	78	10.77873	9.99407	33
28	9.21610	75	9.22205	78	10.77795	9.99404	32
29	9.21685	76	9.22283	78	10.77717	9.99402	31
30	9.21761	75	9.22361	77	10.77639	9.99400	30
31	9.21836	76	9.22438	78	10.77562	9.99398	29
32	9.21912	75	9.22516	77	10.77484	9.99396	28
33	9.21987	75	9.22593	77	10.77407	9.99394	27
34	9.22062	75	9.22670	77	10.77330	9.99392	26
35	9.22137	74	9.22747	77	10.77253	9.99390	25
36	9.22211	75	9.22824	77	10.77176	9.99388	24
37	9.22286	75	9.22901	76	10.77099	9.99385	23
38	9.22361	74	9.22977	77	10.77023	9.99383	22
39	9.22435	74	9.23054	76	10.76946	9.99381	21
40	9.22509	74	9.23130	76	10.76870	9.99379	20
41	9.22583	74	9.23206	77	10.76794	9.99377	19
42	9.22657	74	9.23283	76	10.76717	9.99375	18
43	9.22731	74	9.23359	76	10.76641	9.99372	17
44	9.22805	73	9.23435	75	10.76565	9.99370	16
45	9.22878	74	9.23510	76	10.76490	9.99368	15
46	9.22952	73	9.23586	75	10.76414	9.99366	14
47	9.23025	73	9.23661	76	10.76339	9.99364	13
48	9.23098	73	9.23737	75	10.76263	9.99362	12
49	9.23171	73	9.23812	75	10.76188	9.99359	11
50	9.23244	73	9.23887	75	10.76113	9.99357	10
51	9.23317	73	9.23962	75	10.76038	9.99355	9
52	9.23390	72	9.24037	75	10.75963	9.99353	8
53	9.23462	73	9.24112	74	10.75888	9.99351	7
54	9.23535	72	9.24186	75	10.75814	9.99348	6
55	9.23607	72	9.24261	74	10.75739	9.99346	5
56	9.23679	73	9.24335	75	10.75665	9.99344	4
57	9.23752	71	9.24410	74	10.75590	9.99342	3
58	9.23823	72	9.24484	74	10.75516	9.99340	2
59	9.23895	72	9.24558	74	10.75442	9.99337	1
60	9.23967		9.24632		10.75368	9.99335	0
	Cof.		Cot		Tang.	Sin.	

80 Degrees.

10 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Coſ.	′
0	9.23967	72	9.24632	74	10.75368	9.99335	60
1	9.24039	71	9.24706	73	10.75294	9.99333	59
2	9.24110	71	9.24779	74	10.75221	9.99331	58
3	9.24181	72	9.24853	73	10.75147	9.99328	57
4	9.24253	71	9.24926	74	10.75074	9.99326	56
5	9.24324	71	9.25000	73	10.75000	9.99324	55
6	9.24395	71	9.25073	73	10.74927	9.99322	54
7	9.24466	70	9.25146	73	10.74854	9.99319	53
8	9.24536	71	9.25219	73	10.74781	9.99317	52
9	9.24607	70	9.25292	72	10.74708	9.99315	51
10	9.24677	71	9.25365	72	10.74635	9.99313	50
11	9.24748	70	9.25437	73	10.74563	9.99310	49
12	9.24818	70	9.25510	72	10.74490	9.99308	48
13	9.24888	70	9.25582	73	10.74418	9.99306	47
14	9.24958	70	9.25655	72	10.74345	9.99304	46
15	9.25028	70	9.25727	72	10.74273	9.99301	45
16	9.25098	70	9.25799	72	10.74201	9.99299	44
17	9.25168	69	9.25871	72	10.74129	9.99297	43
18	9.25237	70	9.25943	72	10.74057	9.99294	42
19	9.25307	69	9.26015	71	10.73985	9.99292	41
20	9.25376	69	9.26086	72	10.73914	9.99290	40
21	9.25445	69	9.26158	71	10.73842	9.99288	39
22	9.25514	69	9.26229	72	10.73771	9.99285	38
23	9.25583	69	9.26301	71	10.73699	9.99283	37
24	9.25652	69	9.26372	71	10.73628	9.99281	36
25	9.25721	69	9.26443	71	10.73557	9.99278	35
26	9.25790	68	9.26514	71	10.73486	9.99276	34
27	9.25858	69	9.26585	70	10.73415	9.99274	33
28	9.25927	68	9.26655	71	10.73345	9.99271	32
29	9.25995	68	9.26726	71	10.73274	9.99269	31
30	9.26063	68	9.26797	70	10.73203	9.99267	30
31	9.26131	68	9.26867	70	10.73133	9.99264	29
32	9.26199	68	9.26937	71	10.73063	9.99262	28
33	9.26267	68	9.27008	70	10.72992	9.99260	27
34	9.26335	68	9.27078	70	10.72922	9.99257	26
35	9.26403	67	9.27148	70	10.72852	9.99255	25
36	9.26470	68	9.27218	70	10.72782	9.99252	24
37	9.26538	67	9.27288	69	10.72712	9.99250	23
38	9.26605	67	9.27357	70	10.72643	9.99248	22
39	9.26672	67	9.27427	69	10.72573	9.99245	21
40	9.26739	67	9.27496	70	10.72504	9.99243	20
41	9.26806	67	9.27566	69	10.72434	9.99241	19
42	9.26873	67	9.27635	69	10.72365	9.99238	18
43	9.26940	67	9.27704	69	10.72296	9.99236	17
44	9.27007	66	9.27773	69	10.72227	9.99233	16
45	9.27073	67	9.27842	69	10.72158	9.99231	15
46	9.27140	66	9.27911	69	10.72089	9.99229	14
47	9.27206	67	9.27980	69	10.72020	9.99226	13
48	9.27273	66	9.28049	68	10.71951	9.99224	12
49	9.27339	66	9.28117	69	10.71883	9.99221	11
50	9.27405	66	9.28186	68	10.71814	9.99219	10
51	9.27471	66	9.28254	69	10.71746	9.99217	9
52	9.27537	65	9.28323	68	10.71677	9.99214	8
53	9.27602	66	9.28391	68	10.71609	9.99212	7
54	9.27663	66	9.28459	68	10.71541	9.99209	6
55	9.27734	65	9.28527	68	10.71473	9.99207	5
56	9.27799	65	9.28595	67	10.71405	9.99204	4
57	9.27864	66	9.28662	68	10.71338	9.99202	3
58	9.27930	65	9.28730	68	10.71270	9.99200	2
59	9.27995	65	9.28798	67	10.71202	9.99197	1
60	9.28060		9.28865		10.71135	9.99195	0
	Coſ.		Cot.		Tang.	Sin.	

79 Degrees.

11 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Coſ.	′
0	9.28060	65	9.28865	68	10.71135	9.99195	60
1	9.28125	65	9.28933	67	10.71067	9.99192	59
2	9.28190	64	9.29000	67	10.71000	9.99190	58
3	9.28254	65	9.29067	67	10.70933	9.99187	57
4	9.28319	65	9.29134	67	10.70866	9.99185	56
5	9.28384	64	9.29201	67	10.70799	9.99182	55
6	9.28448	64	9.29268	67	10.70732	9.99180	54
7	9.28512	65	9.29335	67	10.70665	9.99177	53
8	9.28577	64	9.29402	66	10.70598	9.99175	52
9	9.28641	64	9.29468	67	10.70532	9.99172	51
10	9.28705	64	9.29535	66	11.70465	9.99170	50
11	9.28769	64	9.29601	67	10.70399	9.99167	49
12	9.28833	63	9.29668	66	10.70332	9.99165	48
13	9.28896	64	9.29734	66	10.70266	9.99162	47
14	9.28960	64	9.29800	66	10.70200	9.99160	46
15	9.29024	63	9.29866	66	10.70134	9.99157	45
16	9.29087	63	9.29932	66	10.70068	9.99155	44
17	9.29150	64	9.29998	66	10.70002	9.99152	43
18	9.29214	63	9.30064	66	10.69936	9.99150	42
19	9.29277	63	9.30130	65	10.69870	9.99147	41
20	9.29340	63	9.30195	66	10.69805	9.99145	40
21	9.29403	63	9.30261	65	10.69739	9.99142	39
22	9.29466	63	9.30326	65	10.69674	9.99140	38
23	9.29529	62	9.30391	66	10.69609	9.99137	37
24	9.29591	63	9.30457	65	10.69543	9.99135	36
25	9.29654	62	9.30522	65	10.69478	9.99132	35
26	9.29716	63	9.30587	65	10.69413	9.99130	34
27	9.29779	62	9.30652	65	10.69348	9.99127	33
28	9.29841	62	9.30717	65	10.69283	9.99124	32
29	9.29903	63	9.30782	64	10.69218	9.99122	31
30	9.29966	62	9.30846	65	10.69154	9.99119	30
31	9.30028	62	9.30911	64	10.69089	9.99117	29
32	9.30090	61	9.30975	65	10.69025	9.99114	28
33	9.30151	62	9.31040	64	10.68960	9.99112	27
34	9.30213	62	9.31104	64	10.68896	9.99109	26
35	9.30275	61	9.31168	65	10.68832	9.99106	25
36	9.30336	62	9.31233	64	10.68767	9.99104	24
37	9.30398	61	9.31297	64	10.68703	9.99101	23
38	9.30459	62	9.31361	64	10.68639	9.99099	22
39	9.30521	61	9.31425	64	10.68575	9.99096	21
40	9.30582	61	9.31489	63	10.68511	9.99093	20
41	9.30643	61	9.31552	64	10.68448	9.99091	19
42	9.30704	61	9.31616	63	10.68384	9.99088	18
43	9.30765	61	9.31679	64	10.68321	9.99086	17
44	9.30826	61	9.31743	63	10.68257	9.99083	16
45	9.30887	60	9.31806	64	10.68194	9.99080	15
46	9.30947	61	9.31870	63	10.68130	9.99078	14
47	9.31008	60	9.31933	63	10.68067	9.99075	13
48	9.31068	61	9.31996	63	10.68004	9.99072	12
49	9.31129	60	9.32059	63	10.67941	9.99070	11
50	9.31189	61	9.32122	63	10.67878	9.99067	10
51	9.31250	60	9.32185	63	10.67815	9.99064	9
52	9.81310	60	9.32248	63	10.67752	9.99062	8
53	9.31370	60	9.32311	62	10.67689	9.99059	7
54	9.31430	60	9.32373	63	10.67627	9.99056	6
55	9.31490	59	9.32436	62	10.67564	9.99054	5
56	9.31549	60	9.32498	63	10.67502	9.99051	4
57	9.31609	60	9.32561	62	10.67439	9.99048	3
58	9.31669	59	9.32623	62	10.67377	9.99046	2
59	9.31728	60	9.32685	62	10.67315	9.99043	1
60	9.31788		9.32747		10.67253	9.99040	0
	Coſ.		Cot.		Tang.	Sin.	

78 Degrees.

LOGARITHMIC SINES AND TANGENTS.

12 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	′
0	9.31788		9.32747		10.67253	9.99040	60
1	9.31847	59	9.32810	63	10.67190	9.99038	59
2	9.31907	60	9.32872	62	10.67128	9.99035	58
3	9.31966	59	9.32933	61	10.67067	9.99032	57
4	9.32025	59	9.32995	62	10.67005	9.99030	56
5	9.32084	59	9.33057	62	10.66943	9.99027	55
6	9.32143	59	9.33119	62	10.66881	9.99024	54
7	9.32202	59	9.33180	61	10.66820	9.99022	53
8	9.32261	59	9.33242	62	10.66758	9.99019	52
9	9.32319	58	9.33303	61	10.66697	9.99016	51
10	9.32378	59	9.33365	62	10.66635	9.99013	50
11	9.32437	59	9.33426	61	10.66574	9.99011	49
12	9.32495	58	9.33487	61	10.66513	9.99008	48
13	9.32553	58	9.33548	61	10.66452	9.99005	47
14	9.32612	59	9.33609	61	10.66391	9.99002	46
15	9.32670	58	9.33670	61	10.66330	9.99000	45
16	9.32728	58	9.33731	61	10.66269	9.98997	44
17	9.32786	58	9.33792	61	10.66208	9.98994	43
18	9.32844	58	9.33853	61	10.66147	9.98991	42
19	9.32902	58	9.33913	60	10.66087	9.98989	41
20	9.32960	58	9.33974	61	10.66026	9.98986	40
21	9.33018	58	9.34034	60	10.65966	9.98983	39
22	9.33075	57	9.34095	61	10.65905	9.98980	38
23	9.33133	58	9.34155	60	10.65845	9.98978	37
24	9.33190	57	9.34215	60	10.65785	9.98975	36
25	9.33248	58	9.34276	61	10.65724	9.98972	35
26	9.33305	57	9.34336	60	10.65664	9.98969	34
27	9.33362	57	9.34396	60	10.65604	9.98967	33
28	9.33420	58	9.34456	60	10.65544	9.98964	32
29	9.33477	57	9.34516	60	10.65484	9.98961	31
30	9.33534	57	9.34576	60	10.65424	9.98958	30
31	9.33591	57	9.34635	59	10.65365	9.98955	29
32	9.33647	56	9.34695	60	10.65305	9.98953	28
33	9.33704	57	9.34755	60	10.65245	9.98950	27
34	9.33761	57	9.34814	59	10.65186	9.98947	26
35	9.33818	57	9.34874	60	10.65126	9.98944	25
36	9.33874	56	9.34933	59	10.65067	9.98941	24
37	9.33931	57	9.34992	59	10.65008	9.98938	23
38	9.33987	56	9.35051	59	10.64949	9.98936	22
39	9.34043	56	9.35111	60	10.64889	9.98933	21
40	9.34100	57	9.35170	59	10.64830	9.98930	20
41	9.34156	56	9.35229	59	10.64771	9.98927	19
42	9.34212	56	9.35288	59	10.64712	9.98924	18
43	9.34268	56	9.35347	59	10.64653	9.98921	17
44	9.34324	56	9.35405	58	10.64595	9.98919	16
45	9.34380	56	9.35464	59	10.64536	9.98916	15
46	9.34436	56	9.35523	59	10.64477	9.98913	14
47	9.34491	55	9.35581	58	10.64419	9.98910	13
48	9.34547	56	9.35640	59	10.64360	9.98907	12
49	9.34602	55	9.35698	58	10.64302	9.98904	11
50	9.34658	56	9.35757	59	10.64243	9.98901	10
51	9.34713	55	9.35815	58	10.64185	9.98898	9
52	9.34769	56	9.35873	58	10.64127	9.98896	8
53	9.34824	55	9.35931	58	10.64069	9.98893	7
54	9.34879	55	9.35989	58	10.64011	9.98890	6
55	9.34934	55	9.36047	58	10.63953	9.98887	5
56	9.34989	55	9.36105	58	10.63895	9.98884	4
57	9.35044	55	9.36163	58	10.63837	9.98881	3
58	9.35099	55	9.36221	58	10.63779	9.98878	2
59	9.35154	55	9.36279	58	10.63721	9.98875	1
60	9.35209	55	9.36336	57	10.63664	9.98872	0
	Cof.		Cot.		Tang.	Sin.	

77 Degrees.

13 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	′
0	9.35209		9.36336		10.63664	9.98872	60
1	9.35263	54	9.36394	58	10.63606	9.98869	59
2	9.35318	55	9.36452	58	10.63548	9.98867	58
3	9.35373	55	9.36509	57	10.63491	9.98864	57
4	9.35427	54	9.36566	57	10.63434	9.98861	56
5	9.35481	54	9.36624	58	10.63376	9.98858	55
6	9.35536	55	9.36681	57	10.63319	9.98855	54
7	9.35590	54	9.36738	57	10.63262	9.98852	53
8	9.35644	54	9.36795	57	10.63205	9.98849	52
9	9.35698	54	9.36852	57	10.63148	9.98846	51
10	9.35752	54	9.36909	57	10.63091	9.98843	50
11	9.35806	54	9.36966	57	10.63034	9.98840	49
12	9.35860	54	9.37023	57	10.62977	9.98837	48
13	9.35914	54	9.37080	57	10.62920	9.98834	47
14	9.35968	54	9.37137	57	10.62863	9.98831	46
15	9.36022	54	9.37193	56	10.62807	9.98828	45
16	9.36075	53	9.37250	57	10.62750	9.98825	44
17	9.36129	54	9.37306	56	10.62694	9.98822	43
18	9.36182	53	9.37363	57	10.62637	9.98819	42
19	9.36236	54	9.37419	56	10.62581	9.98816	41
20	9.36289	53	9.37476	57	10.62524	9.98813	40
21	9.36342	53	9.37532	56	10.62468	9.98810	39
22	9.36395	53	9.37588	56	10.62412	9.98807	38
23	9.36449	54	9.37644	56	10.62356	9.98804	37
24	9.36502	53	9.37700	56	10.62300	9.98801	36
25	9.36555	53	9.37756	56	10.62244	9.98798	35
26	9.36608	53	9.37812	56	10.62188	9.98795	34
27	9.36660	52	9.37868	56	10.62132	9.98792	33
28	9.36713	53	9.37924	56	10.62076	9.98789	32
29	9.36766	53	9.37980	56	10.62020	9.98786	31
30	9.36819	53	9.38035	55	10.61965	9.98783	30
31	9.36871	52	9.38091	56	10.61909	9.98780	29
32	9.36924	53	9.38147	56	10.61853	9.98777	28
33	9.36976	52	9.38202	55	10.61798	9.98774	27
34	9.37028	52	9.38257	55	10.61743	9.98771	26
35	9.37081	53	9.38313	56	10.61687	9.98768	25
36	9.37133	52	9.38368	55	10.61632	9.98765	24
37	9.37185	52	9.38423	55	10.61577	9.98762	23
38	9.37237	52	9.38479	56	10.61521	9.98759	22
39	9.37289	52	9.38534	55	10.61466	9.98756	21
40	9.37341	52	9.38589	55	10.61411	9.98753	20
41	9.37393	52	9.38644	55	10.61356	9.98750	19
42	9.37445	52	9.38699	55	10.61301	9.98746	18
43	9.37497	52	9.38754	55	10.61246	9.98743	17
44	9.37549	52	9.38808	54	10.61192	9.98740	16
45	9.37600	51	9.38863	55	10.61137	9.98737	15
46	9.37652	52	9.38918	55	10.61082	9.98734	14
47	9.37703	51	9.38972	54	10.61028	9.98731	13
48	9.37755	52	9.39027	55	10.60973	9.98728	12
49	9.37806	51	9.39082	55	10.60918	9.98725	11
50	9.37858	52	9.39136	54	10.60864	9.98722	10
51	9.37909	51	9.39190	54	10.60810	9.98719	9
52	9.37960	51	9.39245	55	10.60755	9.98715	8
53	9.38011	51	9.39299	54	10.60701	9.98712	7
54	9.38062	51	9.39353	54	10.60647	9.98709	6
55	9.38113	51	9.39407	54	10.60593	9.98706	5
56	9.38164	51	9.39461	54	10.60539	9.98703	4
57	9.38215	51	9.39515	54	10.60485	9.98700	3
58	9.38266	51	9.39569	54	10.60431	9.98697	2
59	9.38317	51	9.39623	54	10.60377	9.98694	1
60	9.38368	51	9.39677	54	10.60323	9.98690	0
	Cof.		Cot.		Tang.	Sin.	

76 Degrees.

14 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	′
0	9.38368		9.39677		10.60323	9.98690	60
1	9.38418	50	9.39731	54	10.60269	9.98687	59
2	9.38469	51	9.39785	54	10.60215	9.98684	58
3	9.38519	50	9.39838	53	10.60162	9.98681	57
4	9.38570	51	9.39892	54	10.60108	9.98678	56
5	9.38620	50	9.39945	53	10.60055	9.98675	55
6	9.38670	50	9.39999	54	10.60001	9.98671	54
7	9.38721	51	9.40052	53	10.59948	9.98668	53
8	9.38771	50	9.40106	54	10.59894	9.98665	52
9	9.38821	50	9.40159	53	10.59841	9.98662	51
10	9.38871	50	9.40212	53	10.59788	9.98659	50
11	9.38921	50	9.40266	54	10.59734	9.98656	49
12	9.38971	50	9.40319	53	10.59681	9.98652	48
13	9.39021	50	9.40372	53	10.59628	9.98649	47
14	9.39071	50	9.40425	53	10.59575	9.98646	46
15	9.39121	50	9.40478	53	10.59522	9.98643	45
16	9.39170	49	9.40531	53	10.59469	9.98640	44
17	9.39220	50	9.40584	53	10.59416	9.98636	43
18	9.39270	50	9.40636	52	10.59364	9.98633	42
19	9.39319	49	9.40689	53	10.59311	9.98630	41
20	9.39369	50	9.40742	53	10.59258	9.98627	40
21	9.39418	49	9.40795	53	10.59205	9.98623	39
22	9.39467	49	9.40847	52	10.59153	9.98620	38
23	9.39517	50	9.40900	53	10.59100	9.98617	37
24	9.39566	49	9.40952	52	10.59048	9.98614	36
25	9.39615	49	9.41005	53	10.58995	9.98610	35
26	9.39664	49	9.41057	52	10.58943	9.98607	34
27	9.39713	49	9.41109	52	10.58891	9.98604	33
28	9.39762	49	9.41161	52	10.58839	9.98601	32
29	9.39811	49	9.41214	53	10.58786	9.98597	31
30	9.39860	49	9.41266	52	10.58734	9.98594	30
31	9.39909	49	9.41318	52	10.58682	9.98591	29
32	9.39958	49	9.41370	52	10.58630	9.98588	28
33	9.40006	48	9.41422	52	10.58578	9.98584	27
34	9.40055	49	9.41474	52	10.58526	9.98581	26
35	9.40103	48	9.41526	52	10.58474	9.98578	25
36	9.40152	49	9.41578	52	10.58422	9.98574	24
37	9.40200	48	9.41629	51	10.58371	9.98571	23
38	9.40249	49	9.41681	52	10.58319	9.98568	22
39	9.40297	48	9.41733	52	10.58267	9.98565	21
40	9.40346	49	9.41784	51	10.58216	9.98561	20
41	9.40394	48	9.41836	52	10.58164	9.98558	19
42	9.40442	48	9.41887	51	10.58113	9.98555	18
43	9.40490	48	9.41939	52	10.58061	9.98551	17
44	9.40538	48	9.41990	51	10.58010	9.98548	16
45	9.40586	48	9.42041	51	10.57959	9.98545	15
46	9.40634	48	9.42093	52	10.57907	9.98541	14
47	9.40682	48	9.42144	51	10.57856	9.98538	13
48	9.40730	48	9.42195	51	10.57805	9.98535	12
49	9.40778	48	9.42246	51	10.57754	9.98531	11
50	9.40825	47	9.42297	51	10.57703	9.98528	10
51	9.40873	48	9.42348	51	10.57652	9.98525	9
52	9.40921	48	9.42399	51	10.57601	9.98521	8
53	9.40968	47	9.42450	51	10.57550	9.98518	7
54	9.41016	48	9.42501	51	10.57499	9.98515	6
55	9.41063	47	9.42552	51	10.57448	9.98511	5
56	9.41111	48	9.42603	51	10.57397	9.98508	4
57	9.41158	47	9.42653	50	10.57347	9.98505	3
58	9.41205	47	9.42704	51	10.57296	9.98501	2
59	9.41252	47	9.42755	51	10.57245	9.98498	1
60	9.41300	48	9.42805	50	10.57195	9.98494	0
	Cos.		Cot.		Tang.	Sin.	

75 Degrees.

15 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	′
0	9.41300		9.42805		10.57195	9.98494	60
1	9.41347	47	9.42856	51	10.57144	9.98491	59
2	9.41394	47	9.42906	50	10.57094	9.98488	58
3	9.41441	47	9.42957	51	10.57043	9.98484	57
4	9.41488	47	9.43007	50	10.56993	9.98481	56
5	9.41535	47	9.43057	50	10.56943	9.98477	55
6	9.41582	47	9.43108	51	10.56892	9.98474	54
7	9.41628	46	9.43158	50	10.56842	9.98471	53
8	9.41675	47	9.43208	50	10.56792	9.98467	52
9	9.41722	47	9.43258	50	10.56742	9.98464	51
10	9.41768	46	9.43308	50	10.56692	9.98460	50
11	9.41815	47	9.43358	50	10.56642	9.98457	49
12	9.41861	46	9.43408	50	10.56592	9.98453	48
13	9.41908	47	9.43458	50	10.56542	9.98450	47
14	9.41954	46	9.43508	50	10.56492	9.98447	46
15	9.42001	47	9.43558	50	10.56442	9.98443	45
16	9.42047	46	9.43607	49	10.56393	9.98440	44
17	9.42093	46	9.43657	50	10.56343	9.98436	43
18	9.42140	47	9.43707	50	10.56293	9.98433	42
19	9.42186	46	9.43756	49	10.56244	9.98429	41
20	9.42232	46	9.43806	50	10.56194	9.98426	40
21	9.42278	46	9.43855	49	10.56145	9.98422	39
22	9.42324	46	9.43905	50	10.56095	9.98419	38
23	9.42370	46	9.43954	49	10.56046	9.98415	37
24	9.42416	46	9.44004	50	10.55996	9.98412	36
25	9.42461	45	9.44053	49	10.55947	9.98409	35
26	9.42507	46	9.44102	49	10.55898	9.98405	34
27	9.42553	46	9.44151	49	10.55849	9.98402	33
28	9.42599	46	9.44201	50	10.55799	9.98398	32
29	9.42644	45	9.44250	49	10.55750	9.98395	31
30	9.42690	46	9.44299	49	10.55701	9.98391	30
31	9.42735	45	9.44348	49	10.55652	9.98388	29
32	9.42781	46	9.44397	49	10.55603	9.98384	28
33	9.42826	45	9.44446	49	10.55554	9.98381	27
34	9.42872	46	9.44495	49	10.55505	9.98377	26
35	9.42917	45	9.44544	49	10.55456	9.98373	25
36	9.42962	45	9.44592	48	10.55408	9.98370	24
37	9.43008	46	9.44641	49	10.55359	9.98366	23
38	9.43053	45	9.44690	49	10.55310	9.98363	22
39	9.43098	45	9.44738	48	10.55262	9.98359	21
40	9.43143	45	9.44787	49	10.55213	9.98356	20
41	9.43188	45	9.44836	49	10.55164	9.98352	19
42	9.43233	45	9.44884	48	10.55116	9.98349	18
43	9.43278	45	9.44933	49	10.55067	9.98345	17
44	9.43323	45	9.44981	48	10.55019	9.98342	16
45	9.43367	44	9.45029	48	10.54971	9.98338	15
46	9.43412	45	9.45078	49	10.54922	9.98334	14
47	9.43457	45	9.45126	48	10.54874	9.98331	13
48	9.43502	45	9.45174	48	10.54826	9.98327	12
49	9.43546	44	9.45222	48	10.54778	9.98324	11
50	9.43591	45	9.45271	49	10.54729	9.98320	10
51	9.43635	44	9.45319	48	10.54681	9.98317	9
52	9.43680	45	9.45367	48	10.54633	9.98313	8
53	9.43724	44	9.45415	48	10.54585	9.98309	7
54	9.43769	45	9.45463	48	10.54537	9.98306	6
55	9.43813	44	9.45511	48	10.54489	9.98302	5
56	9.43857	44	9.45559	48	10.54441	9.98299	4
57	9.43901	44	9.45606	47	10.54394	9.98295	3
58	9.43946	45	9.45654	48	10.54346	9.98291	2
59	9.43990	44	9.45702	48	10.54298	9.98288	1
60	9.44034	44	9.45750	48	10.54250	9.98284	0
	Cos.		Cot.		Tang.	Sin.	

74 Degrees.

16 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	′
0	9.44034	44	9.45750	47	10.54250	9.98284	60
1	9.44078	44	9.45797	48	10.54203	9.98281	59
2	9.44122	44	9.45845	47	10.54155	9.98277	58
3	9.44166	44	9.45892	48	10.54108	9.98273	57
4	9.44210	43	9.45940	47	10.54060	9.98270	56
5	9.44253	44	9.45987	48	10.54013	9.98266	55
6	9.44297	44	9.46035	47	10.53965	9.98262	54
7	9.44341	44	9.46082	48	10.53618	9.98259	53
8	9.44385	43	9.46130	47	10.53870	9.98255	52
9	9.44428	44	9.46177	47	10.53823	9.98211	51
10	9.44472	44	9.46224	47	10.53776	9.98248	50
11	9.44516	43	9.46271	48	10.53729	9.98244	49
12	9.44559	43	9.46319	47	10.53681	9.98240	48
13	9.44602	44	9.46366	47	10.53634	9.98237	47
14	9.44646	43	9.46413	47	10.53587	9.98233	46
15	9.44689	44	9.46460	47	10.53540	9.98229	45
16	9.44733	43	9.46507	47	10.53493	9.98226	44
17	9.44776	43	9.46554	47	10.53446	9.98222	43
18	9.44819	43	9.46601	47	10.53399	9.98218	42
19	9.44862	43	9.46648	46	10.53352	9.98215	41
20	9.44905	43	9.46694	47	10.53306	9.98211	40
21	9.44948	44	9.46741	47	10.53259	9.98207	39
22	9.44992	43	9.46788	47	10.53212	9.98204	38
23	9.45035	42	9.46835	46	10.53165	9.98200	37
24	9.45077	43	9.46881	47	10.53119	9.98196	36
25	9.45120	43	9.46928	47	10.53072	9.98192	35
26	9.45163	43	9.46975	46	10.53025	9.98189	34
27	9.45206	43	9.47021	47	10.52979	9.98185	33
28	9.45249	43	9.47068	46	10.52932	9.98181	32
29	9.45292	42	9.47114	46	10.52886	9.98177	31
30	9.45334	43	9.47160	47	10.52840	9.98174	30
31	9.45377	42	9.47207	46	10.52793	9.98170	29
32	9.45419	43	9.47253	46	10.52747	9.98166	28
33	9.45462	42	9.47299	47	10.52701	9.98162	27
34	9.45504	43	9.47346	46	10.52654	9.98159	26
35	9.45547	42	9.47392	46	10.52608	9.98155	25
36	9.45589	43	9.47438	46	10.52562	9.98151	24
37	9.45632	42	9.47484	46	10.52516	9.98147	23
38	9.45674	42	9.47530	46	10.52470	9.98144	22
39	9.45716	42	9.47576	46	10.52424	9.98140	21
40	9.45758	43	9.47622	46	10.52378	9.98136	20
41	9.45801	42	9.47668	46	10.52332	9.98132	19
42	9.45843	42	9.47714	46	10.52286	9.98129	18
43	9.45885	42	9.47760	46	10.52240	9.98125	17
44	9.45927	42	9.47806	46	10.52194	9.98121	16
45	9.45969	42	9.47852	45	10.52148	9.98117	15
46	9.46011	42	9.47897	46	10.52103	9.98113	14
47	9.46053	42	9.47943	46	10.52057	9.98110	13
48	9.46095	41	9.47989	46	10.52011	9.98106	12
49	9.46136	42	9.48035	45	10.51965	9.98102	11
50	9.46178	42	9.48080	46	10.51920	9.98098	10
51	9.46220	42	9.48126	45	10.51874	9.98094	9
52	9.46262	41	9.48171	46	10.51829	9.98090	8
53	9.46303	42	9.48217	45	10.51783	9.98087	7
54	9.46345	41	9.48262	45	10.51738	9.98083	6
55	9.46386	42	9.48307	46	10.51693	9.98079	5
56	9.46428	41	9.48353	45	10.51647	9.98075	4
57	9.46469	42	9.48398	45	10.51602	9.98071	3
58	9.46511	41	9.48443	46	10.51557	9.98067	2
59	9.46552	42	9.48489	45	10.51511	9.98063	1
60	9.46594		9.48534		10.51466	9.98060	0
	Cof.		Cot.		Tang.	Sin.	′

73 Degrees.

17 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	′
0	9.46594	41	9.48534	45	10.51466	9.98060	60
1	9.46635	41	9.48579	45	10.51421	9.98056	59
2	9.46676	41	9.48624	45	10.51376	9.98052	58
3	9.46717	41	9.48669	45	10.51331	9.98048	57
4	9.46758	42	9.48714	45	10.51286	9.98044	56
5	9.46800	41	9.48759	45	10.51241	9.98040	55
6	9.46841	41	9.48804	45	10.51196	9.98036	54
7	9.46882	41	9.48849	45	10.51151	9.98032	53
8	9.46923	41	9.48894	45	10.51106	9.98029	52
9	9.46964	41	9.48939	45	10.51061	9.98025	51
10	9.47005	40	9.48984	45	10.51016	9.98021	50
11	9.47045	41	9.49029	44	10.50971	9.98017	49
12	9.47086	41	9.49073	45	10.50927	9.98013	48
13	9.47127	41	9.49118	45	10.50882	9.98009	47
14	9.47168	41	9.49163	44	10.50837	9.98005	46
15	9.47209	40	9.49207	45	10.50793	9.98001	45
16	9.47249	41	9.49252	44	10.50748	9.97997	44
17	9.47290	40	9.49296	45	10.50704	9.97993	43
18	9.47330	41	9.49341	44	10.50659	9.97989	42
19	9.47371	40	9.49385	45	10.50615	9.97986	41
20	9.47411	41	9.49430	44	10.50570	9.97982	40
21	9.47452	40	9.49474	45	10.50526	9.97978	39
22	9.47492	41	9.49519	44	10.50481	9.97974	38
23	9.47533	40	9.49563	44	10.50437	9.97970	37
24	9.47573	40	9.49607	45	10.50393	9.97966	36
25	9.47613	41	9.49652	44	10.50348	9.97962	35
26	9.47654	40	9.49696	44	10.50304	9.97958	34
27	9.47694	40	9.49740	44	10.50260	9.97954	33
28	9.47734	40	9.49784	44	10.50216	9.97950	32
29	9.47774	40	9.49828	44	10.50172	9.97946	31
30	9.47814	40	9.49872	44	10.50128	9.97942	30
31	9.47854	40	9.49916	44	10.50084	9.97938	29
32	9.47894	40	9.49960	44	10.50040	9.97934	28
33	9.47934	40	9.50004	44	10.49996	9.97930	27
34	9.47974	40	9.50048	44	10.49952	9.97926	26
35	9.48014	40	9.50092	44	10.49908	9.97922	25
36	9.48054	40	9.50136	44	10.49864	9.97918	24
37	9.48094	39	9.50180	43	10.49820	9.97914	23
38	9.48133	40	9.50223	44	10.49777	9.97910	22
39	9.48173	40	9.50267	44	10.49733	9.97906	21
40	9.48213	39	9.50311	44	10.49689	9.97902	20
41	9.48252	40	9.50355	43	10.49645	9.97898	19
42	9.48292	40	9.50398	44	10.49602	9.97894	18
43	9.48332	39	9.50442	43	10.49558	9.97890	17
44	9.48371	40	9.50485	44	10.49515	9.97886	16
45	9.48411	39	9.50529	43	10.49471	9.97882	15
46	9.48450	40	9.50572	44	10.49428	9.97878	14
47	9.48490	39	9.50616	43	10.49384	9.97874	13
48	9.48529	39	9.50659	44	10.49341	9.97870	12
49	9.48568	39	9.50703	43	10.49297	9.97866	11
50	9.48607	40	9.50746	43	10.49254	9.97861	10
51	9.48647	39	9.50789	44	10.49211	9.97857	9
52	9.48686	39	9.50833	43	10.49167	9.97853	8
53	9.48725	39	9.50876	43	10.49124	9.97849	7
54	9.48764	39	9.50919	43	10.49081	9.97845	6
55	9.48803	39	9.50962	43	10.49038	9.97841	5
56	9.48842	39	9.51005	43	10.48995	9.97837	4
57	9.48881	39	9.51048	44	10.48952	9.97833	3
58	9.48920	39	9.51092	43	10.48908	9.97829	2
59	9.48959	39	9.51135	43	10.48865	9.97825	1
60	9.48998		9.51178		10.48822	9.97821	0
	Cof.		Cot		Tang.	Sin.	′

72 Degrees.

18 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.48998	39	9.51178	43	10.48822	9.97821	4	60
1	9.49037	39	9.51221	43	10.48779	9.97817	5	59
2	9.49076	39	9.51264	42	10.48736	9.97812	4	58
3	9.49115	38	9.51306	43	10.48694	9.97808	4	57
4	9.49153	39	9.51349	43	10.48651	9.97804	4	56
5	9.49192	39	9.51392	43	10.48608	9.97800	4	55
6	9.49231	38	9.51435	43	10.48565	9.97796	4	54
7	9.49269	39	9.51478	42	10.48522	9.97792	4	53
8	9.49308	39	9.51520	43	10.48480	9.97788	4	52
9	9.49347	38	9.51563	43	10.48437	9.97784	5	51
10	9.49385	39	9.51606	42	10.48394	9.97779	4	50
11	9.49424	38	9.51648	43	10.48352	9.97775	4	49
12	9.49462	38	9.51691	43	10.48309	9.97771	4	48
13	9.49500	39	9.51734	42	10.48266	9.97767	4	47
14	9.49539	38	9.51776	43	10.48224	9.97763	4	46
15	9.49577	38	9.51819	42	10.48181	9.97759	5	45
16	9.49615	39	9.51861	42	10.48139	9.97754	4	44
17	9.49654	38	9.51903	43	10.48097	9.97750	4	43
18	9.49692	38	9.51946	42	10.48054	9.97746	4	42
19	9.49730	38	9.51988	43	10.48012	9.97742	4	41
20	9.49768	38	9.52031	42	10.47969	9.97738	4	40
21	9.49806	38	9.52073	42	10.47927	9.97734	5	39
22	9.49844	38	9.52115	42	10.47885	9.97729	4	38
23	9.49882	38	9.52157	43	10.47843	9.97725	4	37
24	9.49920	38	9.52200	42	10.47800	9.97721	4	36
25	9.49958	38	9.52242	42	10.47758	9.97717	4	35
26	9.49996	38	9.52284	42	10.47716	9.97713	5	34
27	9.50034	38	9.52326	42	10.47674	9.97708	4	33
28	9.50072	38	9.52368	42	10.47632	9.97704	4	32
29	9.50110	38	9.52410	42	10.47590	9.97700	4	31
30	9.50148	37	9.52452	42	10.47548	9.97696	5	30
31	9.50185	38	9.52494	42	10.47506	9.97691	4	29
32	9.50223	38	9.52536	42	10.47464	9.97687	4	28
33	9.50261	37	9.52578	42	10.47422	9.97683	4	27
34	9.50298	38	9.52620	41	10.47380	9.97679	5	26
35	9.50336	38	9.52661	42	10.47339	9.97674	4	25
36	9.50374	37	9.52703	42	10.47297	9.97670	4	24
37	9.50411	38	9.52745	42	10.47255	9.97666	4	23
38	9.50449	37	9.52787	42	10.47213	9.97662	5	22
39	9.50486	37	9.52829	41	10.47171	9.97657	4	21
40	9.50523	38	9.52870	42	10.47130	9.97653	4	20
41	9.50561	37	9.52912	41	10.47088	9.97649	4	19
42	9.50598	37	9.52953	42	10.47047	9.97645	5	18
43	9.50635	38	9.52995	42	10.47005	9.97640	4	17
44	9.50673	37	9.53037	41	10.46963	9.97636	4	16
45	9.50710	37	9.53078	42	10.46922	9.97632	4	15
46	9.50747	37	9.53120	41	10.46880	9.97628	5	14
47	9.50784	37	9.53161	41	10.46839	9.97623	4	13
48	9.50821	37	9.53202	42	10.46798	9.97619	4	12
49	9.50858	38	9.53244	41	10.46756	9.97615	5	11
50	9.50896	37	9.53285	42	10.46715	9.97610	4	10
51	9.50933	37	9.53327	41	10.46673	9.97606	4	9
52	9.50970	37	9.53368	41	10.46632	9.97602	5	8
53	9.51007	36	9.53409	41	10.46591	9.97597	4	7
54	9.51043	37	9.53450	42	10.46550	9.97593	4	6
55	9.51080	37	9.53492	41	10.46508	9.97589	5	5
56	9.51117	37	9.53533	41	10.46467	9.97584	4	4
57	9.51154	37	9.53574	41	10.46426	9.97580	4	3
58	9.51191	36	9.53615	41	10.46385	9.97576	5	2
59	9.51227	37	9.53656	41	10.46344	9.97571	4	1
60	9.51264		9.53697		10.46303	9.97567		0
	Cos.		Cot.		Tang.	Sin.		

71 Degrees.

19 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.51264	37	9.53697	41	10.46303	9.97567	4	60
1	9.51301	37	9.53738	41	10.46262	9.97563	5	59
2	9.51338	36	9.53779	41	10.46221	9.97558	4	58
3	9.51374	37	9.53820	41	10.46180	9.97554	4	57
4	9.51411	36	9.53861	41	10.46139	9.97550	5	56
5	9.51447	37	9.53902	41	10.46098	9.97545	4	55
6	9.51484	36	9.53943	41	10.46057	9.97541	5	54
7	9.51520	37	9.53984	41	10.46016	9.97536	4	53
8	9.51557	36	9.54025	40	10.45975	9.97532	4	52
9	9.51593	36	9.54065	41	10.45935	9.97528	5	51
10	9.51629	37	9.54106	41	10.45894	9.97523	4	50
11	9.51666	36	9.54147	40	10.45853	9.97519	4	49
12	9.51702	36	9.54187	41	10.45813	9.97515	5	48
13	9.51738	36	9.54228	41	10.45772	9.97510	4	47
14	9.51774	37	9.54269	40	10.45731	9.97506	5	46
15	9.51811	36	9.54309	41	10.45691	9.97501	4	45
16	9.51847	36	9.54350	40	10.45650	9.97497	5	44
17	9.51883	36	9.54390	41	10.45610	9.97492	4	43
18	9.51919	36	9.54431	40	10.45569	9.97488	4	42
19	9.51955	36	9.54471	41	10.45529	9.97484	5	41
20	9.51991	36	9.54512	40	10.45488	9.97479	4	40
21	9.52027	36	9.54552	41	10.45448	9.97475	5	39
22	9.52063	36	9.54593	40	10.45407	9.97470	4	38
23	9.52099	36	9.54633	40	10.45367	9.97466	5	37
24	9.52135	36	9.54673	41	10.45327	9.97461	4	36
25	9.52171	36	9.54714	40	10.45286	9.97457	4	35
26	9.52207	35	9.54754	40	10.45246	9.97453	5	34
27	9.52242	36	9.54794	41	10.45206	9.97448	4	33
28	9.52278	36	9.54835	40	10.45165	9.97444	5	32
29	9.52314	36	9.54875	40	10.45125	9.97439	4	31
30	9.52350	35	9.54915	40	10.45085	9.97435	5	30
31	9.52385	36	9.54955	40	10.45045	9.97430	4	29
32	9.52421	35	9.54995	40	10.45005	9.97426	5	28
33	9.52456	36	9.55035	40	10.44965	9.97421	4	27
34	9.52492	35	9.55075	40	10.44925	9.97417	5	26
35	9.52527	36	9.55115	40	10.44885	9.97412	4	25
36	9.52563	35	9.55155	40	10.44845	9.97408	5	24
37	9.52598	36	9.55195	40	10.44805	9.97403	4	23
38	9.52634	35	9.55235	40	10.44765	9.97399	5	22
39	9.52669	36	9.55275	40	10.44725	9.97394	4	21
40	9.52705	35	9.55315	40	10.44685	9.97390	5	20
41	9.52740	35	9.55355	40	10.44645	9.97385	4	19
42	9.52775	36	9.55395	39	10.44605	9.97381	5	18
43	9.52811	35	9.55434	40	10.44566	9.97376	4	17
44	9.52846	35	9.55474	40	10.44526	9.97372	5	16
45	9.52881	35	9.55514	40	10.44486	9.97367	4	15
46	9.52916	35	9.55554	39	10.44446	9.97363	4	14
47	9.52951	35	9.55593	40	10.44407	9.97359	5	13
48	9.52986	35	9.55633	40	10.44367	9.97353	4	12
49	9.53021	35	9.55673	39	10.44327	9.97349	5	11
50	9.53056	36	9.55712	40	10.44288	9.97344	4	10
51	9.53092	34	9.55752	39	10.44248	9.97340	5	9
52	9.53126	35	9.55791	40	10.44209	9.97335	4	8
53	9.53161	35	9.55831	39	10.44169	9.97331	5	7
54	9.53196	35	9.55870	40	10.44130	9.97326	4	6
55	9.53231	35	9.55910	39	10.44090	9.97322	5	5
56	9.53266	35	9.55949	40	10.44051	9.97317	5	4
57	9.53301	35	9.55989	39	10.44011	9.97312	4	3
58	9.53336	34	9.56028	39	10.43972	9.97308	5	2
59	9.53370	35	9.56067	40	10.43933	9.97303	4	1
60	9.53405		9.56107		10.43893	9.97299		0
	Cos.		Cot.		Tang.	Sin.		

70 Degrees.

20 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.53405	35	9.56107	39	10.43893	9.97299	5	60
1	9.53440	35	9.56146	39	10.43854	9.97294	5	59
2	9.53475	34	9.56185	39	10.43815	9.97289	4	58
3	9.53509	35	9.56224	40	10.43776	9.97285	5	57
4	9.53544	34	9.56264	39	10.43736	9.97280	4	56
5	9.53578	35	9.56303	39	10.43697	9.97276	5	55
6	9.53613	34	9.56342	39	10.43658	9.97271	5	54
7	9.53647	35	9.56381	39	10.43619	9.97266	4	53
8	9.53682	34	9.56420	39	10.43580	9.97262	5	52
9	9.53716	35	9.56459	39	10.43541	9.97257	5	51
10	9.53751	34	9.56498	39	10.43502	9.97252	4	50
11	9.53785	34	9.56537	39	10.43463	9.97248	5	49
12	9.53819	35	9.56576	39	10.43424	9.97243	5	48
13	9.53854	34	9.56615	39	10.43385	9.97238	4	47
14	9.53888	34	9.56654	39	10.43346	9.97234	5	46
15	9.53922	35	9.56693	39	10.43307	9.97229	5	45
16	9.53957	34	9.56732	39	10.43268	9.97224	4	44
17	9.53991	34	9.56771	39	10.43229	9.97220	5	43
18	9.54025	34	9.56810	39	10.43190	9.97215	5	42
19	9.54059	34	9.56849	38	10.43151	9.97210	4	41
20	9.54093	34	9.56887	39	10.43113	9.97206	5	40
21	9.54127	34	9.56926	39	10.43074	9.97201	5	39
22	9.54161	34	9.56965	39	10.43035	9.97196	4	38
23	9.54195	34	9.57004	38	10.42996	9.97192	5	37
24	9.54229	34	9.57042	39	10.42958	9.97187	5	36
25	9.54263	34	9.57081	39	10.42919	9.97182	4	35
26	9.54297	34	9.57120	38	10.42880	9.97178	5	34
27	9.54331	34	9.57158	39	10.42842	9.97173	5	33
28	9.54365	34	9.57197	38	10.42803	9.97168	5	32
29	9.54399	34	9.57235	39	10.42765	9.97163	4	31
30	9.54433	33	9.57274	38	10.42726	9.97159	5	30
31	9.54466	34	9.57312	39	10.42688	9.97154	5	29
32	9.54500	34	9.57351	38	10.42649	9.97149	4	28
33	9.54534	33	9.57389	39	10.42611	9.97145	5	27
34	9.54567	34	9.57428	38	10.42572	9.97140	5	26
35	9.54601	34	9.57466	38	10.42534	9.97135	5	25
36	9.54635	33	9.57504	39	10.42496	9.97130	4	24
37	9.54668	34	9.57543	38	10.42457	9.97126	5	23
38	9.54702	33	9.57581	38	10.42419	9.97121	5	22
39	9.54735	34	9.57619	39	10.42381	9.97116	5	21
40	9.54769	33	9.57658	38	10.42342	9.97111	4	20
41	9.54802	34	9.57696	38	10.42304	9.97107	5	19
42	9.54836	33	9.57734	38	10.42266	9.97102	5	18
43	9.54869	34	9.57772	38	10.42228	9.97097	5	17
44	9.54903	33	9.57810	39	10.42190	9.97092	5	16
45	9.54936	33	9.57849	38	10.42151	9.97087	4	15
46	9.54969	34	9.57887	38	10.42113	9.97083	5	14
47	9.55003	33	9.57925	38	10.42075	9.97078	5	13
48	9.55036	33	9.57963	38	10.42037	9.97073	5	12
49	9.55069	33	9.58001	38	10.41999	9.97068	5	11
50	9.55102	34	9.58039	38	10.41961	9.97063	4	10
51	9.55136	33	9.58077	38	10.41923	9.97059	5	9
52	9.55169	33	9.58115	38	10.41885	9.97054	5	8
53	9.55202	33	9.58153	38	10.41847	9.97049	5	7
54	9.55235	33	9.58191	38	10.41809	9.97044	5	6
55	9.55268	33	9.58229	38	10.41771	9.97039	4	5
56	9.55301	33	9.58267	37	10.41733	9.97035	5	4
57	9.55334	33	9.58304	38	10.41696	9.97030	5	3
58	9.55367	33	9.58342	38	10.41658	9.97025	5	2
59	9.55400	33	9.58380	38	10.41620	9.97020	5	1
60	9.55433		9.58418		10.41582	9.97015		0
	Cos.		Cot.		Tang.	Sin.		
69 Degrees.								

21 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.55433	33	9.58418	37	10.41582	9.97015	5	60
1	9.55466	33	9.58455	38	10.41545	9.97010	5	59
2	9.55499	33	9.58493	38	10.41507	9.97005	4	58
3	9.55532	32	9.58531	38	10.41469	9.97001	5	57
4	9.55564	33	9.58569	37	10.41431	9.96996	5	56
5	9.55597	33	9.58606	38	10.41394	9.96991	5	55
6	9.55630	33	9.58644	37	10.41356	9.96986	5	54
7	9.55663	32	9.58681	38	10.41319	9.96981	5	53
8	9.55695	33	9.58719	38	10.41281	9.96976	5	52
9	9.55728	33	9.58757	37	10.41243	9.96971	5	51
10	9.55761	32	9.58794	38	10.41206	9.96966	4	50
11	9.55793	33	9.58832	37	10.41168	9.96962	5	49
12	9.55826	32	9.58869	38	10.41131	9.96957	5	48
13	9.55858	33	9.58907	37	10.41093	9.96952	5	47
14	9.55891	32	9.58944	37	10.41056	9.96947	5	46
15	9.55923	33	9.58981	38	10.41019	9.96942	5	45
16	9.55956	32	9.59019	37	10.40981	9.96937	5	44
17	9.55988	33	9.59056	38	10.40944	9.96932	5	43
18	9.56021	32	9.59094	37	10.40906	9.96927	5	42
19	9.56053	32	9.59131	37	10.40869	9.96922	5	41
20	9.56085	33	9.59168	37	10.40832	9.96917	5	40
21	9.56118	32	9.59205	38	10.40795	9.96912	5	39
22	9.56150	32	9.59243	37	10.40757	9.96907	4	38
23	9.56182	33	9.59280	37	10.40720	9.96903	5	37
24	9.56215	32	9.59317	37	10.40683	9.96898	5	36
25	9.56247	32	9.59354	37	10.40646	9.96893	5	35
26	9.56279	32	9.59391	38	10.40609	9.96888	5	34
27	9.56311	32	9.59429	37	10.40571	9.96883	5	33
28	9.56343	32	9.59466	37	10.40534	9.96878	5	32
29	9.56375	33	9.59503	37	10.40497	9.96873	5	31
30	9.56408	32	9.59540	37	10.40460	9.96868	5	30
31	9.56440	32	9.59577	37	10.40423	9.96863	5	29
32	9.56472	32	9.59614	37	10.40386	9.96858	5	28
33	9.56504	32	9.59651	37	10.40349	9.96853	5	27
34	9.56536	32	9.59688	37	10.40312	9.96848	5	26
35	9.56568	31	9.59725	37	10.40275	9.96843	5	25
36	9.56599	32	9.59762	37	10.40238	9.96838	5	24
37	9.56631	32	9.59799	36	10.40201	9.96833	5	23
38	9.56663	32	9.59835	37	10.40165	9.96828	5	22
39	9.56695	32	9.59872	37	10.40128	9.96823	5	21
40	9.56727	32	9.59909	37	10.40091	9.96818	5	20
41	9.56759	31	9.59946	37	10.40054	9.96813	5	19
42	9.56790	32	9.59983	36	10.40017	9.96808	5	18
43	9.56822	32	9.60019	37	10.39981	9.96803	5	17
44	9.56854	32	9.60056	37	10.39944	9.96798	5	16
45	9.56886	31	9.60093	37	10.39907	9.96793	5	15
46	9.56917	32	9.60130	36	10.39870	9.96788	5	14
47	9.56949	31	9.60166	37	10.39834	9.96783	5	13
48	9.56980	32	9.60203	37	10.39797	9.96778	6	12
49	9.57012	32	9.60240	36	10.39760	9.96772	5	11
50	9.57044	31	9.60276	37	10.39724	9.96767	5	10
51	9.57075	32	9.60313	36	10.39687	9.96762	5	9
52	9.57107	31	9.60349	37	10.39651	9.96757	5	8
53	9.57138	31	9.60386	36	10.39614	9.96752	5	7
54	9.57169	32	9.60422	37	10.39578	9.96747	5	6
55	9.57201	31	9.60459	36	10.39541	9.96742	5	5
56	9.57232	32	9.60495	37	10.39505	9.96737	5	4
57	9.57264	31	9.60532	36	10.39468	9.96732	5	3
58	9.57295	31	9.60568	37	10.39432	9.96727	5	2
59	9.57326	32	9.60605	36	10.39395	9.96722	5	1
60	9.57358		9.60641		10.39359	9.96717		0
	Cos.		Cot.		Tang.	Sin.		
68 Degrees.								

22 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Coſ.	D.	′
0	9.57358	31	9.60641	36	10.39359	9.96717	6	60
1	9.57389	31	9.60677	37	10.39323	9.96711	5	59
2	9.57420	31	9.60714	36	10.39286	9.96706	5	58
3	9.57451	31	9.60750	36	10.39250	9.96701	5	57
4	9.57482	32	9.60786	37	10.39214	9.96696	5	56
5	9.57514	31	9.60823	36	10.39177	9.96691	5	55
6	9.57545	31	9.60859	36	10.39141	9.96686	5	54
7	9.57576	31	9.60895	36	10.39105	9.96681	5	53
8	9.57607	31	9.60931	36	10.39069	9.96676	6	52
9	9.57638	31	9.60967	37	10.39033	9.96670	5	51
10	9.57669	31	9.61004	36	10.38996	9.96665	5	50
11	9.57700	31	9.61040	36	10.38960	9.96660	5	49
12	9.57731	31	9.61076	36	10.38924	9.96655	5	48
13	9.57762	31	9.61112	36	10.38888	9.96650	5	47
14	9.57793	31	9.61148	36	10.38852	9.96645	5	46
15	9.57824	31	9.61184	36	10.38816	9.96640	6	45
16	9.57855	30	9.61220	36	10.38780	9.96634	5	44
17	9.57885	31	9.61256	36	10.38744	9.96629	5	43
18	9.57916	31	9.61292	36	10.38708	9.96624	5	42
19	9.57947	31	9.61328	36	10.38672	9.96619	5	41
20	9.57978	30	9.61364	36	10.38636	9.96614	6	40
21	9.58008	31	9.61400	36	10.38600	9.96608	5	39
22	9.58039	31	9.61436	36	10.38564	9.96603	5	38
23	9.58070	31	9.61472	36	10.38528	9.96598	5	37
24	9.58101	30	9.61508	36	10.38492	9.96593	5	36
25	9.58131	31	9.61544	35	10.38456	9.96588	6	35
26	9.58162	30	9.61579	36	10.38421	9.96582	5	34
27	9.58192	31	9.61615	36	10.38385	9.96577	5	33
28	9.58223	30	9.61651	36	10.38349	9.96572	5	32
29	9.58253	31	9.61687	35	10.38313	9.96567	5	31
30	9.58284	30	9.61722	36	10.38278	9.96562	6	30
31	9.58314	31	9.61758	36	10.38242	9.96556	5	29
32	9.58345	30	9.61794	36	10.38206	9.96551	5	28
33	9.58375	31	9.61830	35	10.38170	9.96546	5	27
34	9.58406	30	9.61865	36	10.38135	9.96541	6	26
35	9.58436	31	9.61901	35	10.38099	9.96535	5	25
36	9.58467	30	9.61936	36	10.38064	9.96530	5	24
37	9.58497	30	9.61972	36	10.38028	9.96525	5	23
38	9.58527	30	9.62008	35	10.37992	9.96520	6	22
39	9.58557	31	9.62043	36	10.37957	9.96514	5	21
40	9.58588	30	9.62079	35	10.37921	9.96509	5	20
41	9.58618	30	9.62114	36	10.37886	9.96504	6	19
42	9.58648	30	9.62150	35	10.37850	9.96498	5	18
43	9.58678	31	9.62185	36	10.37815	9.96493	5	17
44	9.58709	30	9.62221	35	10.37779	9.96488	5	16
45	9.58739	30	9.62256	36	10.37744	9.96483	6	15
46	9.58769	30	9.62292	35	10.37708	9.96477	5	14
47	9.58799	30	9.62327	35	10.37673	9.96472	5	13
48	9.58829	30	9.62362	36	10.37638	9.96467	6	12
49	9.58859	30	9.62398	35	10.37602	9.96461	5	11
50	9.58889	30	9.62433	35	10.37567	9.96456	5	10
51	9.58919	30	9.62468	36	10.37532	9.96451	6	9
52	9.58949	30	9.62504	35	10.37496	9.96445	5	8
53	9.58979	30	9.62539	35	10.37461	9.96440	5	7
54	9.59009	30	9.62574	35	10.37426	9.96435	6	6
55	9.59039	30	9.62609	36	10.37391	9.96429	5	5
56	9.59069	29	9.62645	35	10.37355	9.96424	5	4
57	9.59098	30	9.62680	35	10.37320	9.96419	6	3
58	9.59128	30	9.62715	35	10.37285	9.96413	5	2
59	9.59158	30	9.62750	35	10.37250	9.96408	5	1
60	9.59188		9.62785		10.37215	9.96403		0
	Coſ.		Cot.		Tang.	Sin.		

67 Degrees.

23 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Coſ.	D.	′
0	9.59188	30	9.62785	35	10.37215	9.96403	6	60
1	9.59218	29	9.62820	35	10.37180	9.96397	5	59
2	9.59247	30	9.62855	35	10.37145	9.96392	5	58
3	9.59277	30	9.62890	36	10.37110	9.96387	6	57
4	9.59307	29	9.62926	35	10.37074	9.96381	5	56
5	9.59336	30	9.62961	35	10.37039	9.96376	6	55
6	9.59366	30	9.62996	35	10.37004	9.96370	5	54
7	9.59396	29	9.63031	35	10.36969	9.96365	5	53
8	9.59425	30	9.63066	35	10.36934	9.96360	6	52
9	9.59455	29	9.63101	34	10.36899	9.96354	5	51
10	9.59484	30	9.63135	35	10.36865	9.96349	6	50
11	9.59514	29	9.63170	35	10.36830	9.96343	5	49
12	9.59543	30	9.63205	35	10.36795	9.96338	5	48
13	9.59573	29	9.63240	35	10.36760	9.96333	6	47
14	9.59602	30	9.63275	35	10.36725	9.96327	5	46
15	9.59632	29	9.63310	35	10.36690	9.96322	6	45
16	9.59661	29	9.63345	34	10.36655	9.96316	5	44
17	9.59690	30	9.63379	35	10.36621	9.96311	6	43
18	9.59720	29	9.63414	35	10.36586	9.96305	5	42
19	9.59749	29	9.63449	35	10.36551	9.96300	6	41
20	9.59778	30	9.63484	35	10.36516	9.96294	5	40
21	9.59808	29	9.63519	34	10.36481	9.96289	5	39
22	9.59837	29	9.63553	35	10.36447	9.96284	6	38
23	9.59866	29	9.63588	35	10.36412	9.96278	5	37
24	9.59895	29	9.63623	34	10.36377	9.96273	6	36
25	9.59924	30	9.63657	35	10.36343	9.96267	5	35
26	9.59954	29	9.63692	34	10.36308	9.96262	6	34
27	9.59983	29	9.63726	35	10.36274	9.96256	5	33
28	9.60012	29	9.63761	35	10.36239	9.96251	6	32
29	9.60041	29	9.63796	34	10.36204	9.96245	5	31
30	9.60070	29	9.63830	35	10.36170	9.96240	6	30
31	9.60099	29	9.63865	34	10.36135	9.96234	5	29
32	9.60128	29	9.63899	35	10.36101	9.96229	6	28
33	9.60157	29	9.63934	34	10.36066	9.96223	5	27
34	9.60186	29	9.63968	35	10.36032	9.96218	6	26
35	9.60215	29	9.64003	34	10.35997	9.96212	5	25
36	9.60244	29	9.64037	35	10.35963	9.96207	6	24
37	9.60273	29	9.64072	34	10.35928	9.96201	5	23
38	9.60302	29	9.64106	34	10.35894	9.96196	6	22
39	9.60331	28	9.64140	35	10.35860	9.96190	5	21
40	9.60359	29	9.64175	34	10.35825	9.96185	6	20
41	9.60388	29	9.64209	34	10.35791	9.96179	5	19
42	9.60417	29	9.64243	35	10.35757	9.96174	6	18
43	9.60446	28	9.64278	34	10.35722	9.96168	6	17
44	9.60474	29	9.64312	34	10.35688	9.96162	5	16
45	9.60503	29	9.64346	35	10.35654	9.96157	6	15
46	9.60532	29	9.64381	34	10.35619	9.96151	5	14
47	9.60561	28	9.64415	34	10.35585	9.96146	6	13
48	9.60589	29	9.64449	34	10.35551	9.96140	5	12
49	9.60618	28	9.64483	34	10.35517	9.96135	6	11
50	9.60646	29	9.64517	35	10.35483	9.96129	6	10
51	9.60675	29	9.64552	34	10.35448	9.96123	5	9
52	9.60704	28	9.64586	34	10.35414	9.96118	6	8
53	9.60732	29	9.64620	34	10.35380	9.96112	5	7
54	9.60761	28	9.64654	34	10.35346	9.96107	6	6
55	9.60789	29	9.64688	34	10.35312	9.96101	6	5
56	9.60818	28	9.64722	34	10.35278	9.96095	5	4
57	9.60846	29	9.64756	34	10.35244	9.96090	6	3
58	9.60875	28	9.64790	34	10.35210	9.96084	5	2
59	9.60903	28	9.64824	34	10.35176	9.96079	6	1
60	9.60931		9.64858		10.35142	9.96073		0
	Coſ.		Cot.		Tang.	Sin.		

66 Degrees.

24 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.60941	29	9.64858	34	10.35142	9.96073	6	60
1	9.60960	28	9.64892	34	10.35108	9.96067	5	59
2	9.60988	28	9.64926	34	10.35074	9.96062	6	58
3	9.61016	29	9.64960	34	10.35040	9.96056	6	57
4	9.61045	28	9.64994	34	10.35006	9.96050	5	56
5	9.61073	28	9.65028	34	10.34972	9.96045	6	55
6	9.61101	28	9.65062	34	10.34938	9.96039	5	54
7	9.61129	29	9.65096	34	10.34904	9.96034	6	53
8	9.61158	28	9.65130	34	10.34870	9.96028	6	52
9	9.61186	28	9.65164	33	10.34836	9.96022	5	51
10	9.61214	28	9.65197	34	10.34803	9.96017	6	50
11	9.61242	28	9.65231	34	10.34769	9.96011	6	49
12	9.61270	28	9.65265	34	10.34735	9.96005	5	48
13	9.61298	28	9.65299	34	10.34701	9.96000	6	47
14	9.61326	28	9.65333	33	10.34667	9.95994	6	46
15	9.61354	28	9.65366	34	10.34634	9.95988	6	45
16	9.61382	29	9.65400	34	10.34600	9.95982	5	44
17	9.61411	27	9.65434	33	10.34566	9.95977	6	43
18	9.61438	28	9.65467	34	10.34533	9.95971	6	42
19	9.61466	28	9.65501	34	10.34499	9.95965	5	41
20	9.61494	28	9.65535	33	10.34465	9.95960	6	40
21	9.61522	28	9.65568	34	10.34432	9.95954	6	39
22	9.61550	28	9.65602	34	10.34398	9.95948	6	38
23	9.61578	28	9.65636	33	10.34364	9.95942	5	37
24	9.61606	28	9.65669	34	10.34331	9.95937	6	36
25	9.61634	28	9.65703	33	10.34297	9.95931	6	35
26	9.61662	27	9.65736	34	10.34264	9.95925	5	34
27	9.61689	28	9.65770	33	10.34230	9.95920	6	33
28	9.61717	28	9.65803	34	10.34197	9.95914	6	32
29	9.61745	28	9.65837	33	10.34163	9.95908	6	31
30	9.61773	27	9.65870	34	10.34130	9.95902	5	30
31	9.61800	28	9.65904	33	10.34096	9.95897	6	29
32	9.61828	28	9.65937	34	10.34063	9.95891	6	28
33	9.61856	27	9.65971	33	10.34029	9.95885	6	27
34	9.61883	28	9.66004	34	10.33996	9.95879	6	26
35	9.61911	28	9.66038	33	10.33962	9.95873	5	25
36	9.61939	27	9.66071	33	10.33929	9.95868	6	24
37	9.61966	28	9.66104	34	10.33896	9.95862	6	23
38	9.61994	27	9.66138	33	10.33862	9.95856	6	22
39	9.62021	28	9.66171	33	10.33829	9.95850	6	21
40	9.62049	27	9.66204	34	10.33796	9.95844	5	20
41	9.62079	28	9.66238	33	10.33762	9.95839	6	19
42	9.62104	27	9.66271	33	10.33729	9.95833	6	18
43	9.62131	28	9.66304	33	10.33696	9.95827	6	17
44	9.62159	27	9.66337	34	10.33663	9.95821	6	16
45	9.62186	28	9.66371	33	10.33629	9.95815	5	15
46	9.62214	27	9.66404	33	10.33596	9.95810	6	14
47	9.62241	27	9.66437	33	10.33563	9.95804	6	13
48	9.62268	28	9.66470	33	10.33530	9.95798	6	12
49	9.62296	27	9.66503	34	10.33497	9.95792	6	11
50	9.62323	27	9.66537	33	10.33463	9.95786	6	10
51	9.62350	27	9.66570	33	10.33430	9.95780	5	9
52	9.62377	28	9.66603	33	10.33397	9.95775	6	8
53	9.62405	27	9.66636	33	10.33364	9.95769	6	7
54	9.62432	27	9.66669	33	10.33331	9.95763	6	6
55	9.62459	27	9.66702	33	10.33298	9.95757	6	5
56	9.62486	27	9.66735	33	10.33265	9.95751	6	4
57	9.62513	28	9.66768	33	10.33232	9.95745	6	3
58	9.62541	27	9.66801	33	10.33199	9.95739	6	2
59	9.62568	27	9.66834	33	10.33166	9.95733	5	1
60	9.62595		9.66867		10.33133	9.95728		0
	Cos.		Cot.		Tang.	Sin.		

65 Degrees.

25 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.62595	27	9.66867	33	10.33133	9.95728	6	60
1	9.62622	27	9.66900	33	10.33100	9.95722	6	59
2	9.62649	27	9.66933	33	10.33067	9.95716	6	58
3	9.62676	27	9.66966	33	10.33034	9.95710	6	57
4	9.62703	27	9.66999	33	10.33001	9.95704	6	56
5	9.62730	27	9.67032	33	10.32968	9.95698	6	55
6	9.62757	27	9.67065	33	10.32935	9.95692	6	54
7	9.62784	27	9.67098	33	10.32902	9.95686	6	53
8	9.62811	27	9.67131	32	10.32869	9.95680	6	52
9	9.62838	27	9.67163	33	10.32837	9.95674	6	51
10	9.62865	27	9.67196	33	10.32804	9.95668	5	50
11	9.62892	26	9.67229	33	10.32771	9.95663	6	49
12	9.62918	27	9.67262	33	10.32738	9.95657	6	48
13	9.62945	27	9.67295	32	10.32705	9.95651	6	47
14	9.62972	27	9.67327	33	10.32673	9.95645	5	46
15	9.62999	27	9.67360	33	10.32740	9.95639	6	45
16	9.63026	26	9.67393	33	10.32607	9.95633	6	44
17	9.63052	27	9.67426	32	10.32574	9.95627	6	43
18	9.63079	27	9.67458	33	10.32542	9.95621	6	42
19	9.63106	27	9.67491	33	10.32509	9.95615	6	41
20	9.63133	26	9.67524	32	10.32476	9.95609	6	40
21	9.63159	27	9.67556	33	10.32444	9.95603	6	39
22	9.63186	27	9.67589	33	10.32411	9.95597	6	38
23	9.63213	26	9.67622	32	10.32378	9.95591	6	37
24	9.63239	27	9.67654	33	10.32346	9.95585	6	36
25	9.63266	26	9.67687	32	10.32313	9.95579	6	35
26	9.63292	27	9.67719	33	10.32281	9.95573	6	34
27	9.63319	26	9.67752	33	10.32248	9.95567	6	33
28	9.63345	27	9.67785	32	10.32215	9.95561	6	32
29	9.63372	26	9.67817	33	10.32183	9.95555	6	31
30	9.63398	27	9.67850	32	10.32150	9.95549	6	30
31	9.63425	26	9.67882	33	10.32118	9.95543	6	29
32	9.63451	27	9.67915	32	10.32085	9.95537	6	28
33	9.63478	26	9.67947	33	10.32053	9.95531	6	27
34	9.63504	77	9.67980	32	10.32020	9.95525	6	26
35	9.63531	26	9.68012	32	10.31988	9.95519	6	25
36	9.63557	26	9.68044	33	10.31956	9.95513	6	24
37	9.63583	27	9.68077	32	10.31923	9.95507	7	23
38	9.63610	26	9.68109	33	10.31891	9.95500	6	22
39	9.63636	26	9.68142	32	10.31858	9.95494	6	21
40	9.63662	27	9.68174	32	10.31826	9.95488	6	20
41	9.63689	26	9.68206	33	10.31794	9.95482	6	19
42	9.63715	26	9.68239	32	10.31761	9.95476	6	18
43	9.63741	26	9.68271	32	10.31729	9.95470	6	17
44	9.63767	27	9.68303	33	10.31697	9.95464	6	16
45	9.63794	26	9.68336	32	10.31664	9.95458	6	15
46	9.63820	26	9.68368	32	10.31632	9.95452	6	14
47	9.63846	26	9.68400	32	10.31600	9.95446	6	13
48	9.63872	26	9.68432	33	10.31568	9.95440	6	12
49	9.63898	26	9.68465	32	10.31535	9.95434	7	11
50	9.63924	26	9.68497	32	10.31503	9.95427	6	10
51	9.63950	26	9.68529	32	10.31471	9.95421	6	9
52	9.63976	26	9.68561	32	10.31439	9.95415	6	8
53	9.64002	26	9.68593	33	10.31407	9.95409	6	7
54	9.64028	26	9.68626	32	10.31374	9.95403	6	6
55	9.64054	26	9.68658	32	10.31342	9.95397	6	5
56	9.64080	26	9.68690	32	10.31310	9.95391	7	4
57	9.64106	26	9.68722	32	10.31278	9.95384	6	3
58	9.64132	26	9.68754	32	10.31246	9.95378	6	2
59	9.64158	26	9.68786	32	10.31214	9.95372	6	1
60	9.64184		9.68818		10.31182	9.95366		0
	Cos.		Cot.		Tang.	Sin.		

64 Degrees.

26 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.64184	26	9.68818	32	10.31182	9.95366	6	60
1	9.64210	26	9.68850	32	10.31150	9.95360	6	59
2	9.64236	26	9.68882	32	10.31118	9.95354	6	58
3	9.64262	26	9.68914	32	10.31086	9.95348	7	57
4	9.64288	25	9.68946	32	10.31054	9.95341	6	56
5	9.64313	26	9.68978	32	10.31022	9.95335	6	55
6	9.64339	26	9.69010	32	10.30990	9.95329	6	54
7	9.64365	26	9.69042	32	10.30958	9.95323	6	53
8	9.64391	26	9.69074	32	10.30926	9.95317	7	52
9	9.64417	25	9.69106	32	10.30894	9.95310	6	51
10	9.64442	26	9.69138	32	10.30862	9.95304	6	50
11	9.64468	26	9.69170	32	10.30830	9.95298	6	49
12	9.64494	25	9.69202	32	10.30798	9.95292	6	48
13	9.64519	26	9.69234	32	10.30766	9.95286	7	47
14	9.64545	26	9.69266	32	10.30734	9.95279	6	46
15	9.64571	25	9.69298	31	10.30702	9.95273	6	45
16	9.64596	26	9.69329	32	10.30671	9.95267	6	44
17	9.64622	25	9.69361	32	10.30639	9.95261	7	43
18	9.64647	26	9.69393	32	10.30607	9.95254	6	42
19	9.64673	25	9.69425	32	10.30575	9.95248	6	41
20	9.64698	26	9.69457	31	10.30543	9.95242	6	40
21	9.64724	25	9.69488	32	10.30512	9.95236	7	39
22	9.64749	26	9.69520	32	10.30480	9.95229	6	38
23	9.64775	25	9.69552	32	10.30448	9.95223	6	37
24	9.64800	26	9.69584	31	10.30416	9.95217	6	36
25	9.64826	25	9.69615	32	10.30385	9.95211	7	35
26	9.64851	26	9.69647	32	10.30353	9.95204	6	34
27	9.64877	25	9.69679	31	10.30321	9.95198	6	33
28	9.64902	25	9.69710	32	10.30290	9.95192	7	32
29	9.64927	26	9.69742	32	10.30258	9.95185	6	31
30	9.64953	25	9.69774	31	10.30226	9.95179	6	30
31	9.64978	25	9.69805	32	10.30195	9.95173	6	29
32	9.65003	26	9.69837	31	10.30163	9.95167	7	28
33	9.65029	25	9.69868	32	10.30132	9.95160	6	27
34	9.65054	25	9.69900	32	10.30100	9.95154	6	26
35	9.65079	25	9.69932	31	10.30068	9.95148	7	25
36	9.65104	26	9.69963	32	10.30037	9.95141	6	24
37	9.65130	25	9.69995	31	10.30005	9.95135	6	23
38	9.65155	25	9.70026	32	10.29974	9.95129	7	22
39	9.65180	25	9.70058	31	10.29942	9.95122	6	21
40	9.65205	25	9.70089	32	10.29911	9.95116	6	20
41	9.65230	25	9.70121	31	10.29879	9.95110	7	19
42	9.65255	26	9.70152	32	10.29848	9.95103	6	18
43	9.65281	25	9.70184	31	10.29816	9.95097	7	17
44	9.65306	25	9.70215	32	10.29785	9.95090	6	16
45	9.65331	25	9.70247	31	10.29753	9.95084	6	15
46	9.65356	25	9.70278	31	10.29722	9.95078	7	14
47	9.65381	25	9.70309	32	10.29691	9.95071	6	13
48	9.65406	25	9.70341	31	10.29659	9.95065	6	12
49	9.65431	25	9.70372	32	10.29628	9.95059	7	11
50	9.65456	25	9.70404	31	10.29596	9.95052	6	10
51	9.65481	25	9.70435	31	10.29565	9.95046	7	9
52	9.65506	25	9.70466	32	10.29534	9.95039	6	8
53	9.65531	25	9.70498	31	10.29502	9.95033	6	7
54	9.65556	24	9.70529	31	10.29471	9.95027	7	6
55	9.65580	25	9.70560	32	10.29440	9.95020	6	5
56	9.65605	25	9.70592	31	10.29408	9.95014	7	4
57	9.65630	25	9.70623	31	10.29377	9.95007	6	3
58	9.65655	25	9.70654	31	10.29346	9.95001	6	2
59	9 65680	25	9.70685	32	10.29315	9.94995	7	1
60	9.65705		9.70717		10.29283	9.94988		0
	Cos.		Cot.		Tang.	Sin.		

63 Degrees.

27 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.65705	24	9.70717	31	10.29283	9.94988	6	60
1	9.65729	25	9.70748	31	10.29252	9.94982	7	59
2	9.65754	25	9.70779	31	10.29221	9.94975	6	58
3	9.65779	25	9.70810	31	10.29190	9.94969	7	57
4	9.65804	24	9.70841	32	10.29159	9.94962	6	56
5	9.65828	25	9.70873	31	10.29127	9.94956	7	55
6	9.65853	25	9.70904	31	10.29096	9.94949	6	54
7	9.65878	24	9.70935	31	10.29065	9.94943	7	53
8	9.65902	25	9.70966	31	10.29034	9.94936	6	52
9	9.65927	25	9.70997	31	10.29003	9.94930	7	51
10	9.65952	24	9.71028	31	10.28972	9.94923	6	50
11	9.65976	25	9.71059	31	10.28941	9.94917	6	49
12	9.66001	24	9.71090	31	10.28910	9.94911	7	48
13	9.66025	25	9.71121	32	10.28879	9.94904	6	47
14	9.66050	25	9.71153	31	10.28847	9.94898	7	46
15	9.66075	24	9.71184	31	10.28816	9.94891	6	45
16	9.66099	25	9.71215	31	10.28785	9.94885	7	44
17	9.66124	24	9.71246	31	10.28754	9.94878	7	43
18	9.66148	25	9.71277	31	10.28723	9.94871	6	42
19	9.66173	24	9.71308	31	10.28692	9.94865	7	41
20	9.66197	24	9.71339	31	10.28661	9.94858	6	40
21	9.66221	25	9.71370	31	10.28630	9.94852	7	39
22	9.66246	24	9.71401	30	10.28599	9.94845	6	38
23	9.66270	25	9.71431	31	10.28569	9.94839	7	37
24	9.66295	24	9.71462	31	10.28538	9.94832	6	36
25	9.66319	24	9.71493	31	10.28507	9.94826	7	35
26	9.66343	25	9.71524	31	10.28476	9.94819	6	34
27	9.66368	24	9.71555	31	10.28445	9.94813	7	33
28	9.66392	24	9.71586	31	10.28414	9.94806	7	32
29	9.66416	25	9.71617	31	10.28383	9.94799	6	31
30	9.66441	24	9.71648	31	10.28352	9.94793	7	30
31	9.66465	24	9.71679	30	10.28321	9.94786	6	29
32	9.66489	24	9.71709	31	10.28291	9.94780	7	28
33	9.66513	24	9.71740	31	10.28260	9.94773	6	27
34	9.66537	25	9.71771	31	10.28229	9.94767	7	26
35	9.66562	24	9.71802	31	10.28198	9.94760	7	25
36	9.66586	24	9.71833	30	10.28167	9.94753	6	24
37	9.66610	24	9.71863	31	10.28137	9.94747	7	23
38	9.66634	24	9.71894	31	10.28106	9.94740	6	22
39	9.66658	24	9.71925	30	10.28075	9.94734	7	21
40	9.66682	24	9.71955	31	10.28045	9.94727	7	20
41	9.66706	25	9.71986	31	10.28014	9.94720	6	19
42	9.66731	24	9.72017	31	10.27983	9.94714	7	18
43	9.66755	24	9.72048	30	10.27952	9.94707	7	17
44	9.66779	24	9.72078	31	10.27922	9.94700	6	16
45	9.66803	24	9.72109	31	10.27891	9.94694	7	15
46	9.66827	24	9.72140	30	10.27860	9.94687	7	14
47	9.66851	24	9.72170	31	10.27830	9.94680	6	13
48	9.66875	24	9.72201	30	10.27799	9.94674	7	12
49	9.66899	23	9.72231	31	10.27769	9.94667	7	11
50	9.66922	24	9.72262	31	10.27738	9.94660	6	10
51	9.66946	24	9.72293	30	10.27707	9.94654	7	9
52	9.66970	24	9.72323	31	10.27677	9.94647	7	8
53	9.66994	24	9.72354	30	10.27646	9.94640	6	7
54	9.67018	24	9.72384	31	10.27616	9.94634	7	6
55	9.67042	24	9.72415	30	10.27585	9.94627	7	5
56	9.67066	24	9.72445	31	10.27555	9.94620	6	4
57	9.67090	23	9.72476	30	10.27524	9.94614	7	3
58	9.67113	24	9.72506	31	10.27494	9.94607	7	2
59	9.67137	24	9.72537	30	10.27463	9.94600	7	1
60	9.67161		9.72567		10.27433	9.94593		0
	Cos.		Cot.		Tang.	Sin.		

62 Degrees.

28 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	D.	′
0	9.67161		9.72567		10.27433	9.94593	6	60
1	9.67185	24	9.72598	31	10.27402	9.94587	7	59
2	9.67208	23	9.72628	30	10.27372	9.94580	7	58
3	9.67232	24	9.72659	31	10.27341	9.94573	6	57
4	9.67256	24	9.72689	30	10.27311	9.94567	7	56
5	9.67280	24	9.72720	31	10.27280	9.94560	7	55
6	9.67303	23	9.72750	30	10.27250	9.94553	7	54
7	9.67327	24	9.72780	30	10.27220	9.94546	6	53
8	9.67350	23	9.72811	31	10.27189	9.94540	7	52
9	9.67374	24	9.72841	30	10.27159	9.94533	7	51
10	9.67398	24	9.72872	31	10.27128	9.94526	7	50
11	9.67421	23	9.72902	30	10.27098	9.94519	6	49
12	9.67445	24	9.72932	30	10.27068	9.94513	7	48
13	9.67468	23	9.72963	31	10.27037	9.94506	7	47
14	9.67492	24	9.72993	30	10.27007	9.94499	7	46
15	9.67515	23	9.73023	30	10.26977	9.94492	7	45
16	9.67539	24	9.73054	31	10.26946	9.94485	6	44
17	9.67562	23	9.73084	30	10.26916	9.94479	7	43
18	9.67586	24	9.73114	30	10.26886	9.94472	7	42
19	9.67609	23	9.73144	30	10.26856	9.94465	7	41
20	9.67633	24	9.73175	31	10.26825	9.94458	7	40
21	9.67656	23	9.73205	30	10.26795	9.94451	6	39
22	9.67680	24	9.73235	30	10.26765	9.94445	7	38
23	9.67703	23	9.73265	30	10.26735	9.94438	7	37
24	9.67726	23	9.73295	30	10.26705	9.94431	7	36
25	9.67750	24	9.73326	31	10.26674	9.94424	7	35
26	9.67773	23	9.73356	30	10.26644	9.94417	7	34
27	9.67796	23	9.73386	30	10.26614	9.94410	6	33
28	9.67820	24	9.73416	30	10.26584	9.94404	7	32
29	9.67843	23	9.73446	30	10.26554	9.94397	7	31
30	9.67866	23	9.73476	30	10.26524	9.94390	7	30
31	9.67890	24	9.73507	31	10.26493	9.94383	7	29
32	9.67913	23	9.73537	30	10.26463	9.94376	7	28
33	9.67936	23	9.73567	30	10.26433	9.94369	7	27
34	9.67959	23	9.73597	30	10.26403	9.94362	7	26
35	9.67982	23	9.73627	30	10.26373	9.94355	6	25
36	9.68006	24	9.73657	30	10.26343	9.94349	7	24
37	9.68029	23	9.73687	30	10.26313	9.94342	7	23
38	9.68052	23	9.73717	30	10.26283	9.94335	7	22
39	9.68075	23	9.73747	30	10.26253	9.94328	7	21
40	9.68098	23	9.73777	30	10.26223	9.94321	7	20
41	9.68121	23	9.73807	30	10.26193	9.94314	7	19
42	9.68144	23	9.73837	30	10.26163	9.94307	7	18
43	9.68167	23	9.73867	30	10.26133	9.94300	7	17
44	9.68190	23	9.73897	30	10.26103	9.94293	7	16
45	9.68213	23	9.73927	30	10.26073	9.94286	7	15
46	9.68237	24	9.73957	30	10.26043	9.94279	6	14
47	9.68260	23	9.73987	30	10.26013	9.94273	7	13
48	9.68283	23	9.74017	30	10.25983	9.94266	7	12
49	9.68305	22	9.74047	30	10.25953	9.94259	7	11
50	9.68328	23	9.74077	30	10.25923	9.94252	7	10
51	9.68351	23	9.74107	30	10.25893	9.94245	7	9
52	9.68374	23	9.74137	30	10.25863	9.94238	7	8
53	9.68397	23	9.74166	29	10.25834	9.94231	7	7
54	9.68420	23	9.74196	30	10.25804	9.94224	7	6
55	9.68443	23	9.74226	30	10.25774	9.94217	7	5
56	9.68466	23	9.74256	30	10.25744	9.94210	7	4
57	9.68489	23	9.74286	30	10.25714	9.94203	7	3
58	9.68512	23	9.74316	30	10.25684	9.94196	7	2
59	9.68534	22	9.74345	29	10.25655	9.94189	7	1
60	9.68557	23	9.74375	30	10.25625	9.94182	7	0
	Cof.		Cot.		Tang.	Sin.		

61 Degrees.

29 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	D.	′
0	9.68557		9.74375		10.25625	9.94182		60
1	9.68580	23	9.74405	30	10.25595	9.94175	7	59
2	9.68603	23	9.74435	30	10.25565	9.94168	7	58
3	9.68625	22	9.74465	30	10.25535	9.94161	7	57
4	9.68648	23	9.74494	29	10.25506	9.94154	7	56
5	9.68671	23	9.74524	30	10.25476	9.94147	7	55
6	9.68694	23	9.74554	30	10.25446	9.94140	7	54
7	9.68716	22	9.74583	29	10.25417	9.94133	7	53
8	9.68739	23	9.74613	30	10.25387	9.94126	7	52
9	9.68762	23	9.74643	30	10.25357	9.94119	7	51
10	9.68784	22	9.74673	30	10.25327	9.94112	7	50
11	9.68807	23	9.74702	29	10.25298	9.94105	7	49
12	9.68829	22	9.74732	30	10.25268	9.94098	7	48
13	9.68852	23	9.74762	30	10.25238	9.94090	8	47
14	9.68875	23	9.74791	29	10.25209	9.94083	7	46
15	9.68897	22	9.74821	30	10.25179	9.94076	7	45
16	9.68920	23	9.74851	30	10.25149	9.94069	7	44
17	9.68942	22	9.74880	29	10.25120	9.94062	7	43
18	9.68965	23	9.74910	30	10.25090	9.94055	7	42
19	9.68987	22	9.74939	29	10.25061	9.94048	7	41
20	9.69010	23	9.74969	30	10.25031	9.94041	7	40
21	9.69032	22	9.74998	29	10.25002	9.94034	7	39
22	9.69055	23	9.75028	30	10.24972	9.94027	7	38
23	9.69077	22	9.75058	30	10.24942	9.94020	7	37
24	9.69100	23	9.75087	29	10.24913	9.94012	8	36
25	9.69122	22	9.75117	30	10.24883	9.94005	7	35
26	9.69144	22	9.75146	29	10.24854	9.93998	7	34
27	9.69167	23	9.75176	30	10.24824	9.93991	7	33
28	9.69189	22	9.75205	29	10.24795	9.93984	7	32
29	9.69212	23	9.75235	30	10.24765	9.93977	7	31
30	9.69234	22	9.75264	29	10.24736	9.93970	7	30
31	9.69256	22	9.75294	30	10.24706	9.93963	7	29
32	9.69279	23	9.75323	29	10.24677	9.93955	8	28
33	9.69301	22	9.75353	30	10.24647	9.93948	7	27
34	9.69323	22	9.75382	29	10.24618	9.93941	7	26
35	9.69345	22	9.75411	29	10.24589	9.93934	7	25
36	9.69368	23	9.75441	30	10.24559	9.93927	7	24
37	9.69390	22	9.75470	29	10.24530	9.93920	7	23
38	9.69412	22	9.75500	30	10.24500	9.93912	8	22
39	9.69434	22	9.75529	29	10.24471	9.93905	7	21
40	9.69456	22	9.75558	29	10.24442	9.93898	7	20
41	9.69479	23	9.75588	30	10.24412	9.93891	7	19
42	9.69501	22	9.75617	29	10.24383	9.93884	7	18
43	9.69523	22	9.75647	30	10.24353	9.93876	8	17
44	9.69545	22	9.75676	29	10.24324	9.93869	7	16
45	9.69567	22	9.75707	29	10.24295	9.93862	7	15
46	9.69589	22	9.75735	30	10.24265	9.93855	7	14
47	9.69611	22	9.75764	29	10.24236	9.93847	8	13
48	9.69633	22	9.75793	29	10.24207	9.93840	7	12
49	9.69655	22	9.75822	29	10.24178	9.93833	7	11
50	9.69677	22	9.75852	30	10.24148	9.93826	7	10
51	9.69699	22	9.75881	29	10.24119	9.93819	7	9
52	9.69721	22	9.75910	29	10.24090	9.93811	8	8
53	9.69743	22	9.75939	29	10.24061	9.93804	7	7
54	9.69765	22	9.75969	30	10.24031	9.93797	7	6
55	9.69787	22	9.75998	29	10.24002	9.93789	8	5
56	9.69809	22	9.76027	29	10.23973	9.93782	7	4
57	9.69831	22	9.76056	29	10.23944	9.93775	7	3
58	9.69853	22	9.76086	30	10.23914	9.93768	7	2
59	9.69875	22	9.76115	29	10.23885	9.93760	8	1
60	9.69897	22	9.76144	29	10.23856	9.93753	7	0
	Cof.		Cot.		Tang.	Sin.		

60 Degrees.

30 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	D.	′
0	9.69897	22	9.76144	29	10.23856	9.93753	7	60
1	9.69919	22	9.76173	29	10.23827	9.93746	8	59
2	9.69941	22	9.76202	29	10.23798	9.93738	7	58
3	9.69963	21	9.76231	30	10.23769	9.93731	7	57
4	9.69984	22	9.76261	29	10.23739	9.93724	7	56
5	9.70006	22	9.76290	29	10.23710	9.93717	8	55
6	9.70028	22	9.76319	29	10.23681	9.93709	7	54
7	9.70050	22	9.76348	29	10.23652	9.93702	7	53
8	9.70072	21	9.76377	29	10.23623	9.93695	8	52
9	9.70093	22	9.76406	29	10.23594	9.93687	7	51
10	9.70115	22	9.76435	29	10.23565	9.93680	7	50
11	9.70137	22	9.76464	29	10.23536	9.93673	8	49
12	9.70159	21	9.76493	29	10.23507	9.93665	7	48
13	9.70180	22	9.76522	29	10.23478	9.93658	8	47
14	9.70202	22	9.76551	29	10.23449	9.93650	7	46
15	9.70224	21	9.76580	29	10.23420	9.93643	7	45
16	9.70245	22	9.76609	30	10.23391	9.93636	8	44
17	9.70267	21	9.76639	29	10.23361	9.93628	7	43
18	9.70288	22	9.76668	29	10.23332	9.93621	7	42
19	9.70310	22	9.76697	28	10.23303	9.93614	8	41
20	9.70332	21	9.76725	29	10.23275	9.93606	7	40
21	9.70353	22	9.76754	29	10.23246	9.93599	8	39
22	9.70375	21	9.76783	29	10.23217	9.93591	7	38
23	9.70396	22	9.76812	29	10.23188	9.93584	7	37
24	9.70418	21	9.76841	29	10.23159	9.93577	8	36
25	9.70439	22	9.76870	29	10.23130	9.93569	7	35
26	9.70461	21	9.76899	29	10.23101	9.93562	8	34
27	9.70482	22	9.76928	29	10.23072	9.93554	7	33
28	9.70504	21	9.76957	29	10.23043	9.93547	8	32
29	9.70525	22	9.76986	29	10.23014	9.93539	7	31
30	9.70547	21	9.77015	29	10.22985	9.93532	7	30
31	9.70568	22	9.77044	29	10.22956	9.93525	8	29
32	9.70590	21	9.77073	28	10.22927	9.93517	7	28
33	9.70611	22	9.77101	29	10.22899	9.93510	8	27
34	9.70633	21	9.77130	29	10.22870	9.93502	7	26
35	9.70654	21	9.77159	29	10.22841	9.93495	8	25
36	9.70675	22	9.77188	29	10.22812	9.93487	7	24
37	9.70697	21	9.77217	29	10.22783	9.93480	8	23
38	9.70718	21	9.77246	28	10.22754	9.93472	7	22
39	9.70739	22	9.77274	29	10.22726	9.93465	8	21
40	9.70761	21	9.77303	29	10.22697	9.93457	7	20
41	9.70782	21	9.77332	29	10.22668	9.93450	8	19
42	9.70803	21	9.77361	29	10.22639	9.93442	7	18
43	9.70824	22	9.77390	28	10.22610	9.93435	8	17
44	9.70846	21	9.77418	29	10.22582	9.93427	7	16
45	9.70867	21	9.77447	29	10.22553	9.93420	8	15
46	9.70888	21	9.77476	29	10.22524	9.93412	7	14
47	9.70909	22	9.77505	28	10.22495	9.93405	8	13
48	9.70931	21	9.77533	29	10.22467	9.93397	7	12
49	9.70952	21	9.77562	29	10.22438	9.93390	8	11
50	9.70973	21	9.77591	28	10.22409	9.93382	7	10
51	9.70994	21	9.77619	29	10.22381	9.93375	8	9
52	9.71015	21	9.77648	29	10.22352	9.93367	7	8
53	9.71036	22	9.77977	29	10.22323	9.93360	8	7
54	9.71058	21	9.77706	28	10.22294	9.93352	8	6
55	9.71079	21	9.77734	29	10.22266	9.93344	7	5
56	9.71100	21	9.77763	28	10.22237	9.93337	8	4
57	9.71121	21	9.77791	29	10.22209	9.93329	7	3
58	9.71142	21	9.77820	29	10.22180	9.93322	8	2
59	9.71163	21	9.77849	28	10.22151	9.93314	7	1
60	9.71184		9.77877		10.22223	9.93307		0
	Cof.		Cot.		Tang.	Sin.		

59 Degrees.

31 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	D.	′
0	9.71184	21	9.77877	29	10.22123	9.93307	8	60
1	9.71205	21	9.77906	29	10.22094	9.93299	8	59
2	9.71226	21	9.77935	28	10.22065	9.93291	7	58
3	9.71247	21	9.77963	29	10.22037	9.93284	8	57
4	9.71268	21	9.77992	28	10.22008	9.93276	7	56
5	9.71289	21	9.78020	29	10.21980	9.93269	8	55
6	9.71310	21	9.78049	28	10.21951	9.93261	8	54
7	9.71331	21	9.78077	29	10.21923	9.93253	7	53
8	9.71352	21	9.78106	29	10.21894	9.93246	8	52
9	9.71373	20	9.78135	28	10.21865	9.93238	8	51
10	9.71393	21	9.78163	29	10.21837	9.93230	7	50
11	9.71414	21	9.78192	28	10.21808	9.93223	8	49
12	9.71435	21	9.78220	29	10.21780	9.93215	8	48
13	9.71456	21	9.78249	28	10.21751	9.93207	7	47
14	9.71477	21	9.78277	29	10.21723	9.93200	8	46
15	9.71498	21	9.78306	28	10.21694	9.93192	8	45
16	9.71519	20	9.78334	29	10.21666	9.93184	7	44
17	9.71539	21	9.78363	28	10.21637	9.93177	8	43
18	9.71560	21	9.78391	28	10.21609	9.93169	8	42
19	9.71581	21	9.78419	29	10.21581	9.93161	7	41
20	9.71602	20	9.78448	28	10.21552	9.93154	8	40
21	9.71622	21	9.78476	29	10.21524	9.93146	8	39
22	9.71643	21	9.78505	28	10.21495	9.93138	7	38
23	9.71664	21	9.78533	29	10.21467	9.93131	8	37
24	9.71685	20	9.78562	28	10.21438	9.93123	8	36
25	9.71705	21	9.78590	28	10.21410	9.93115	7	35
26	9.71726	21	9.78618	29	10.21382	9.93108	8	34
27	9.71747	20	9.78647	28	10.21353	9.93100	8	33
28	9.71767	21	9.78675	29	10.21325	9.93092	8	32
29	9.71788	21	9.78704	28	10.21296	9.93084	7	31
30	9.71809	20	9.78732	28	10.21268	9.93077	8	30
31	9.71829	21	9.78760	29	10.21240	9.93069	8	29
32	9.71850	20	9.78789	28	10.21211	9.93061	8	28
33	9.71870	21	9.78817	28	10.21183	9.93053	7	27
34	9.71891	20	9.78845	29	10.21155	9.93046	8	26
35	9.71911	21	9.78874	28	10.21126	9.93038	8	25
36	9.71932	20	9.78902	28	10.21098	9.93030	8	24
37	9.71952	21	9.78930	29	10.21070	9.93022	8	23
38	9.71973	21	9.78959	28	10.21041	9.93014	7	22
39	9.71994	20	9.78987	28	10.21013	9.93007	8	21
40	9.72014	20	9.79015	28	10.20985	9.92999	8	20
41	9.72034	21	9.79043	29	10.20957	9.92991	8	19
42	9.72055	20	9.79072	28	10.20928	9.92983	7	18
43	9.72075	20	9.79100	28	10.20900	9.92976	8	17
44	9.72096	20	9.79128	28	10.20872	9.92968	8	16
45	9.72116	21	9.79156	29	10.20844	9.92960	8	15
46	9.72137	20	9.79185	28	10.20815	9.92952	8	14
47	9.72157	20	9.79213	28	10.20787	9.92944	8	13
48	9.72177	21	9.79241	28	10.20759	9.92936	7	12
49	9.72198	20	9.79269	28	10.20731	9.92929	8	11
50	9.72218	20	9.79297	29	10.20703	9.92921	8	10
51	9.72238	21	9.79326	28	10.20674	9.92913	8	9
52	9.72259	20	9.79354	28	10.20646	9.92905	8	8
53	9.72279	20	9.79382	28	10.20618	9.92897	8	7
54	9.72299	21	9.79410	28	10.20590	9.92889	8	6
55	9.72320	20	9.79438	28	10.20562	9.92881	7	5
56	9.72340	20	9.79466	29	10.20534	9.92874	8	4
57	9.72360	21	9.79495	28	10.20505	9.92866	8	3
58	9.72381	20	9.79523	28	10.20477	9.92858	8	2
59	9.72401	20	9.79551	28	10.20449	9.92850	8	1
60	9.72421		9.79579		10.20421	9.92842		0
	Cof.		Cot.		Tang.	Sin.		

58 Degrees.

32 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.72421	20	9.79579	28	10.20421	9.92842	8	60
1	9.72441	20	9.79607	28	10.20393	9.92834	8	59
2	9.72461	21	9.79635	28	10.20365	9.92826	8	58
3	9.72482	20	9.79663	28	10.20337	9.92818	8	57
4	9.72502	20	9.79691	28	10.20309	9.92810	7	56
5	9.72522	20	9.79719	28	10.20281	9.92803	8	55
6	9.72542	20	9.79747	29	10.20253	9.92795	8	54
7	9.72562	20	9.79776	28	10.20224	9.92787	8	53
8	9.72582	20	9.79804	28	10.20196	9.92779	8	52
9	9.72602	20	9.79832	28	10.20168	9.92771	8	51
10	9.72622	21	9.79860	28	10.20140	9.92763	8	50
11	9.72643	20	9.79888	28	10.20112	9.92755	8	49
12	9.72663	20	9.79916	28	10.20084	9.92747	8	48
13	9.72683	20	9.79944	28	10.20056	9.92739	8	47
14	9.72703	20	9.79972	28	10.20028	9.92731	8	46
15	9.72723	20	9.80000	28	10.20000	9.92723	8	45
16	9.72743	20	9.80028	28	10.19972	9.92715	8	44
17	9.72763	20	9.80056	28	10.19944	9.92707	8	43
18	9.72783	20	9.80084	28	10.19916	9.92699	8	42
19	9.72803	20	9.80112	28	10.19888	9.92691	8	41
20	9.72823	20	9.80140	28	10.19860	9.92683	8	40
21	9.72843	20	9.80168	27	10.19832	9.92675	8	39
22	9.72863	20	9.80195	28	10.19805	9.92667	8	38
23	9.72883	19	9.80223	28	10.19777	9.92659	8	37
24	9.72902	20	9.80251	28	10.19749	9.92651	8	36
25	9.72922	20	9.80279	28	10.19721	9.92643	8	35
26	9.72942	20	9.80307	28	10.19693	9.92635	8	34
27	9.72962	20	9.80335	28	10.19665	9.92627	8	33
28	9.72982	20	9.80363	28	10.19637	9.92619	8	32
29	9.73002	20	9.80391	28	10.19609	9.92611	8	31
30	9.73022	19	9.80419	28	10.19581	9.92603	8	30
31	9.73041	20	9.80447	27	10.19553	9.92595	8	29
32	9.73061	20	9.80474	28	10.19526	9.92587	8	28
33	9.73081	20	9.80502	28	10.19498	9.92579	8	27
34	9.73101	20	9.80530	28	10.19470	9.92571	8	26
35	9.73121	19	9.80558	28	10.19442	9.92563	8	25
36	9.73140	20	9.80586	28	10.19414	9.92555	9	24
37	9.73160	20	9.80614	28	10.19386	9.92546	8	23
38	9.73180	20	9.80642	27	10.19358	9.92538	8	22
39	9.73200	19	9.80669	28	10.19331	9.92530	8	21
40	9.73219	20	9.80697	28	10.19303	9.92522	8	20
41	9.73239	20	9.80725	28	10.19275	9.92514	8	19
42	9.73259	19	9.80753	28	10.19247	9.92506	8	18
43	9.73278	20	9.80781	27	10.19219	9.92498	8	17
44	9.73298	20	9.80808	28	10.19192	9.92490	8	16
45	9.73318	19	9.80836	28	10.19164	9.92482	9	15
46	9.73337	20	9.80864	28	10.19136	9.92473	8	14
47	9.73357	20	9.80892	27	10.19108	9.92465	8	13
48	9.73377	19	9.80919	28	10.19081	9.92457	8	12
49	9.73396	20	9.80947	28	10.19053	9.92449	8	11
50	9.73416	19	9.80975	28	10.19025	9.92441	8	10
51	9.73435	20	9.81003	27	10.18997	9.92433	8	9
52	9.73455	19	9.81030	28	10.18970	9.92425	9	8
53	9.73474	20	9.81058	28	10.18942	9.92416	8	7
54	9.73494	19	9.81086	27	10.18914	9.92408	8	6
55	9.73513	20	9.81113	28	10.18887	9.92400	8	5
56	9.73533	19	9.81141	28	10.18859	9.92392	8	4
57	9.73552	20	9.81169	27	10.18831	9.92384	8	3
58	9.73572	19	9.81196	28	10.18804	9.92376	9	2
59	9.73591	20	9.81224	28	10.18776	9.92367	8	1
60	9.73611		9.81252		10.18748	9.92359		0
	Cos.		Cot.		Tang.	Sin.		

57 Degrees.

33 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.73611	19	9.81252	27	10.18748	9.92359	8	60
1	9.73630	20	9.81279	28	10.18721	9.92351	8	59
2	9.73650	19	9.81307	28	10.18693	9.92343	8	58
3	9.73669	20	9.81335	27	10.18665	9.92335	9	57
4	9.73689	19	9.81362	28	10.18638	9.92326	8	56
5	9.73708	19	9.81390	28	10.18610	9.92318	8	55
6	9.73727	20	9.81418	27	10.18582	9.92310	8	54
7	9.73747	19	9.81445	28	10.18555	9.92302	9	53
8	9.73766	19	9.81473	27	10.18527	9.92293	8	52
9	9.73785	20	9.81500	28	10.18500	9.92285	8	51
10	9.73805	19	9.81528	28	10.18472	9.92277	8	50
11	9.73824	19	9.81556	27	10.18444	9.92269	9	49
12	9.73843	20	9.81583	28	10.18417	9.92260	8	48
13	9.73863	19	9.81611	27	10.18389	9.92252	8	47
14	9.73882	19	9.81638	28	10.18362	9.92244	9	46
15	9.73901	20	9.81666	27	10.18334	9.92235	8	45
16	9.73921	19	9.81693	28	10.18307	9.92227	8	44
17	9.73940	19	9.81721	27	10.18279	9.92219	8	43
18	9.73959	19	9.81748	28	10.18252	9.92211	9	42
19	9.73978	19	9.81776	27	10.18224	9.92202	8	41
20	9.73997	20	9.81803	28	10.18197	9.92194	8	40
21	9.74017	19	9.81831	27	10.18169	9.92186	9	39
22	9.74036	19	9.81858	28	10.18142	9.92177	8	38
23	9.74055	19	9.81886	27	10.18114	9.92169	8	37
24	9.74074	19	9.81913	28	10.18087	9.92161	9	36
25	9.74093	20	9.81941	27	10.18059	9.92152	8	35
26	9.74113	19	9.81968	28	10.18032	9.92144	8	34
27	9.74132	19	9.81996	27	10.18004	9.92136	9	33
28	9.74151	19	9.82023	28	10.17977	9.92127	8	32
29	9.74170	19	9.82051	27	10.17949	9.92119	8	31
30	9.74189	19	9.82078	28	10.17922	9.92111	9	30
31	9.74208	19	9.82106	27	10.17894	9.92102	8	29
32	9.74227	19	9.82133	28	10.17867	9.92094	8	28
33	9.74246	19	9.82161	27	10.17839	9.92086	9	27
34	9.74265	19	9.82188	27	10.17812	9.92077	8	26
35	9.74284	19	9.82215	28	10.17785	9.92069	9	25
36	9.74303	19	9.82243	27	10.17757	9.92060	8	24
37	9.74322	19	9.82270	28	10.17730	9.92052	8	23
38	9.74341	19	9.82298	27	10.17702	9.92044	9	22
39	9.74360	19	9.82325	27	10.17675	9.92035	8	21
40	9.74379	19	9.82352	28	10.17748	9.92027	9	20
41	9.74398	19	9.82380	27	10.17620	9.92018	8	19
42	9.74417	19	9.82407	28	10.17593	9.92010	8	18
43	9.74436	19	9.82435	27	10.17565	9.92002	9	17
44	9.74455	19	9.82462	27	10.17538	9.92993	8	16
45	9.74474	19	9.82489	28	10.17511	9.91985	9	15
46	9.74493	19	9.82517	27	10.17483	9.91976	8	14
47	9.74512	19	9.82544	27	10.17456	9.91968	9	13
48	9.74531	18	9.82571	28	10.17429	9.91959	8	12
49	9.74549	19	9.82599	27	10.17401	9.91951	9	11
50	9.74568	19	9.82626	27	10.17374	9.91942	8	10
51	9.74587	19	9.82653	28	10.17347	9.91934	9	9
52	9.74606	19	9.82681	27	10.17319	9.91925	8	8
53	9.74625	19	9.82708	27	10.17292	9.91917	9	7
54	9.74644	18	9.82735	27	10.17265	9.91908	8	6
55	9.74662	19	9.82762	28	10.17238	9.91900	9	5
56	9.74681	19	9.82790	27	10.17210	9.91891	8	4
57	9.74700	19	9.82817	27	10.17183	9.91883	9	3
58	9.74719	18	9.82844	27	10.17156	9.91874	8	2
59	9.74737	19	9.82871	28	10.17129	9.91866	9	1
60	9.74756		9.82899		10.17101	9.91857		0
	Cos.		Cot.		Tang.	Sin.		

56 Degrees.

34 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.74756	19	9.82899	27	10.17101	9.91857	8	60
1	9.74775	19	9.82926	27	10.17074	9.91849	9	59
2	9.74794	18	9.82953	27	10.17047	9.91840	8	58
3	9.74812	19	9.82980	28	10.17020	9.91832	9	57
4	9.74831	19	9.83008	27	10.16992	9.91823	8	56
5	9.74850	18	9.83035	27	10.16965	9.91815	9	55
6	9.74868	19	9.83062	27	10.16938	9.91806	8	54
7	9.74887	19	9.83089	28	10.16911	9.91798	9	53
8	9.74906	18	9.83117	27	10.16883	9.91789	8	52
9	9.74924	19	9.83144	27	10.16856	9.91781	9	51
10	9.74943	18	9.83171	27	10.16829	9.91772	9	50
11	9.74961	19	9.83198	27	10.16802	9.91763	8	49
12	9.74980	19	9.83225	27	10.16775	9.91755	9	48
13	9.74999	18	9.83252	28	10.16748	9.91746	8	47
14	9.75017	19	9.83280	27	10.16720	9.91738	9	46
15	9.75036	18	9.83307	27	10.16693	9.91729	9	45
16	9.75054	19	9.83334	27	10.16666	9.91720	8	44
17	9.75073	18	9.83361	27	10.16639	9.91712	9	43
18	9.75091	19	9.83388	27	10.16612	9.91703	8	42
19	9.75110	18	9.83415	27	10.16585	9.91695	9	41
20	9.75128	19	9.83442	28	10.16558	9.91686	9	40
21	9.75147	18	9.83470	27	10.16530	9.91677	8	39
22	9.75165	19	9.83497	27	10.16503	9.91669	9	38
23	9.75184	18	9.83524	27	10.16476	9.91660	9	37
24	9.75202	19	9.83551	27	10.16449	9.91651	8	36
25	9.75221	18	9.83578	27	10.16422	9.91643	9	35
26	9.75239	19	9.83605	27	10.16395	9.91634	9	34
27	9.75258	18	9.83632	27	10.16368	9.91625	8	33
28	9.75276	18	9.83659	27	10.16341	9.91617	9	32
29	9.75294	19	9.83686	27	10.16314	9.91608	9	31
30	9.75313	18	9.83713	27	10.16287	9.91599	8	30
31	9.75331	19	9.83740	28	10.16260	9.91591	9	29
32	9.75350	18	9.83768	27	10.16232	9.91582	9	28
33	9.75368	18	9.83795	27	10.16205	9.91573	8	27
34	9.75386	19	9.83822	27	10.16178	9.91565	9	26
35	9.75405	18	9.83849	27	10.16151	9.91556	9	25
36	9.75423	18	9.83876	27	10.16124	9.91547	9	24
37	9.75441	18	9.83903	27	10.16097	9.91538	8	23
38	9.75459	19	9.83930	27	10.16070	9.91530	9	22
39	9.75478	18	9.83957	27	10.16043	9.91521	9	21
40	9.75496	18	9.83984	27	10.16016	9.91512	8	20
41	9.75514	19	9.84011	27	10.15989	9.91504	9	19
42	9.75533	18	9.84038	27	10.15962	9.91495	9	18
43	9.75551	18	9.84065	27	10.15935	9.91486	9	17
44	9.75569	18	9.84092	27	10.15908	9.91477	8	16
45	9.75587	18	9.84119	27	10.15881	9.91469	9	15
46	9.75605	19	9.84146	27	10.15854	9.91460	9	14
47	9.75624	18	9.84173	27	10.15827	9.91451	9	13
48	9.75642	18	9.84200	27	10.15800	9.91442	9	12
49	9.75660	18	9.84227	27	10.15773	9.91433	8	11
50	9.75678	18	9.84254	26	10.15746	9.91425	9	10
51	9.75696	18	9.84280	27	10.15720	9.91416	9	9
52	9.75714	19	9.84307	27	10.15693	9.91407	9	8
53	9.75733	18	9.84334	27	10.15666	9.91398	9	7
54	9.75751	18	9.84361	27	10.15639	9.91389	8	6
55	9.75769	18	9.84388	27	10.15612	9.91381	9	5
56	9.75787	18	9.84415	27	10.15585	9.91372	9	4
57	9.75805	18	9.84442	27	10.15558	9.91363	9	3
58	9.75823	18	9.84469	27	10.15531	9.91354	9	2
59	9.75841	18	9.84496	27	10.15504	9.91345	9	1
60	9.75859		9.84523		10.15477	9.91336		0
	Cos.		Cot.		Tang.	Sin.		

55 Degrees.

35 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.75859	18	9.84523	27	10.15477	9.91336	8	60
1	9.75877	18	9.84550	26	10.15450	9.91328	9	59
2	9.75895	18	9.84576	27	10.15424	9.91319	9	58
3	9.75913	18	9.84603	27	10.15397	9.91310	9	57
4	9.75931	18	9.84630	27	10.15370	9.91301	9	56
5	9.75949	18	9.84657	27	10.15343	9.91292	9	55
6	9.75967	18	9.84684	27	10.15316	9.91283	9	54
7	9.75985	18	9.84711	27	10.15289	9.91274	8	53
8	9.76003	18	9.84738	26	10.15262	9.91266	9	52
9	9.76021	18	9.84764	27	10.15236	9.91257	9	51
10	9.76039	18	9.84791	27	10.15209	9.91248	9	50
11	9.76057	18	9.84818	27	10.15182	9.91239	9	49
12	9.76075	18	9.84845	27	10.15155	9.91230	9	48
13	9.76093	18	9.84872	27	10.15128	9.91221	9	47
14	9.76111	18	9.84899	26	10.15101	9.91212	9	46
15	9.76129	17	9.84925	27	10.15075	9.91203	9	45
16	9.76146	18	9.84952	27	10.15048	9.91194	9	44
17	9.76164	18	9.84979	27	10.15021	9.91185	9	43
18	9.76182	18	9.85006	27	10.14994	9.91176	9	42
19	9.76200	18	9.85033	26	10.14967	9.91167	9	41
20	9.76218	18	9.85059	27	10.14941	9.91158	9	40
21	9.76236	17	9.85086	27	10.14914	9.91149	8	39
22	9.76253	18	9.85113	27	10.14887	9.91141	9	38
23	9.76271	18	9.85140	26	10.14860	9.91132	9	37
24	9.76289	18	9.85166	27	10.14834	9.91123	9	36
25	9.76307	17	9.85193	27	10.14807	9.91114	9	35
26	9.76324	18	9.85220	27	10.14780	9.91105	9	34
27	9.76342	18	9.85247	26	10.14753	9.91096	9	33
28	9.76360	18	9.85273	27	10.14727	9.91087	9	32
29	9.76378	17	9.85300	27	10.14700	9.91078	9	31
30	9.76395	18	9.85327	27	10.14673	9.91069	9	30
31	9.76413	18	9.85354	26	10.14646	9.91060	9	29
32	9.76431	17	9.85380	27	10.14620	9.91051	9	28
33	9.76448	18	9.85407	27	10.14593	9.91042	9	27
34	9.76466	18	9.85434	26	10.14566	9.91033	10	26
35	9.76484	17	9.85460	27	10.14540	9.91023	9	25
36	9.76501	18	9.85487	27	10.14513	9.91014	9	24
37	9.76519	18	9.85514	26	10.14486	9.91005	9	23
38	9.76537	17	9.85540	27	10.14460	9.90996	9	22
39	9.76554	18	9.85567	27	10.14433	9.90987	9	21
40	9.76572	18	9.85594	26	10.14406	9.90978	9	20
41	9.76590	17	9.85620	27	10.14380	9.90969	9	19
42	9.76607	18	9.85647	27	10.14353	9.90960	9	18
43	9.76625	17	9.85674	26	10.14326	9.90951	9	17
44	9.76642	18	9.85700	27	10.14300	9.90942	9	16
45	9.76660	17	9.85727	27	10.14273	9.90933	9	15
46	9.76677	18	9.85754	26	10.14246	9.90924	9	14
47	9.76695	17	9.85780	27	10.14220	9.90915	9	13
48	9.76712	18	9.85807	27	10.14193	9.90906	10	12
49	9.76730	17	9.85834	26	10.14166	9.90896	9	11
50	9.76747	18	9.85860	27	10.14140	9.90887	9	10
51	9.76765	17	9.85887	26	10.14113	9.90878	9	9
52	9.76782	18	9.85913	27	10.14087	9.90869	9	8
53	9.76800	17	9.85940	27	10.14060	9.90860	9	7
54	9.76817	18	9.85967	26	10.14033	9.90851	9	6
55	9.76835	17	9.85993	27	10.14007	9.90842	10	5
56	9.76852	18	9.86020	26	10.13980	9.90832	9	4
57	9.76870	17	9.86046	27	10.13954	9.90823	9	3
58	9.76887	17	9.86073	27	10.13927	9.90814	9	2
59	9.76904	18	9.86100	26	10.13900	9.90805	9	1
60	9.76922		9.86126		10.13874	9.90796		0
	Cos.		Cot.		Tang.	Sin.		

54 Degrees.

36 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	D.	′
0	9.76922	17	9.86126	27	10.13874	9.90796	9	60
1	9.76939	18	9.86153	26	10.13847	9.90787	10	59
2	9.76957	17	9.86179	27	10.13821	9.90777	9	58
3	9.76974	17	9.86206	26	10.13794	9.90768	9	57
4	9.76991	18	9.86232	27	10.13768	9.90759	9	56
5	9.77009	17	9.86259	26	10.13741	9.90750	9	55
6	9.77026	17	9.86285	27	10.13715	9.90741	10	54
7	9.77043	18	9.86312	26	10.13688	9.90731	9	53
8	9.77061	17	9.86338	27	10.13662	9.90722	9	52
9	9.77078	17	9.86365	27	10.13635	9.90713	9	51
10	9.77095	17	9.86392	26	10.13608	9.90704	10	50
11	9.77112	18	9.86418	27	10.13582	9.90694	9	49
12	9.77130	17	9.86445	26	10.13555	9.90685	9	48
13	9.77147	17	9.86471	27	10.13529	9.90676	9	47
14	9.77164	17	9.86498	26	10.13502	9.90667	10	46
15	9.77181	18	9.86524	27	10.13476	9.90657	9	45
16	9.77199	17	9.86551	26	10.13449	9.90648	9	44
17	9.77216	17	9.86577	26	10.13423	9.90639	9	43
18	9.77233	17	9.86603	27	10.13397	9.90630	10	42
19	9.77250	18	9.86630	26	10.13370	9.90620	9	41
20	9.77268	17	9.86656	27	10.13344	9.90611	9	40
21	9.77285	17	9.86683	26	10.13317	9.90602	10	39
22	9.77302	17	9.86709	27	10.13291	9.90592	9	38
23	9.77319	17	9.86736	26	10.13264	9.90583	9	37
24	9.77336	17	9.86762	27	10.13238	9.90574	9	36
25	9.77353	17	9.86789	26	10.13211	9.90565	10	35
26	9.77370	17	9.86815	27	10.13185	9.90555	9	34
27	9.77387	18	9.86842	26	10.13158	9.90546	9	33
28	9.77405	17	9.86868	26	10.13132	9.90537	10	32
29	9.77422	17	9.86894	27	10.13106	9.90527	9	31
30	9.77439	17	9.86921	26	10.13079	9.90518	9	30
31	9.77456	17	9.86947	27	10.13053	9.90509	10	29
32	9.77473	17	9.86974	26	10.13026	9.90499	9	28
33	9.77490	17	9.87000	27	10.13000	9.90490	10	27
34	9.77507	17	9.87027	26	10.12973	9.90480	9	26
35	9.77524	17	9.87053	26	10.12947	9.90471	9	25
36	9.77541	17	9.87079	27	10.12921	9.90462	10	24
37	9.77558	17	9.87106	26	10.12894	9.90452	9	23
38	9.77575	17	9.87132	26	10.12868	9.90443	9	22
39	9.77592	17	9.87158	27	10.12842	9.90434	10	21
40	9.77609	17	9.87185	26	10.12815	9.90424	9	20
41	9.77626	17	9.87211	27	10.12789	9.90415	10	19
42	9.77643	17	9.87238	26	10.12762	9.90405	9	18
43	9.77660	17	9.87264	26	10.12736	9.90396	10	17
44	9.77677	17	9.87290	27	10.12710	9.90386	9	16
45	9.77694	17	9.87317	26	10.12683	9.90377	9	15
46	9.77711	17	9.87343	26	10.12657	9.90368	10	14
47	9.77728	16	9.87369	27	10.12631	9.90358	9	13
48	9.77744	17	9.87396	26	10.12604	9.90349	10	12
49	9.77761	17	9.87422	26	10.12578	9.90339	9	11
50	9.77778	17	9.87448	27	10.12552	9.90330	10	10
51	9.77795	17	9.87475	26	10.12525	9.90320	9	9
52	9.77812	17	9.87501	26	10.12499	9.90311	10	8
53	9.77829	17	9.87527	27	10.12473	9.90301	9	7
54	9.77846	16	9.87554	26	10.12446	9.90292	10	6
55	9.77862	17	9.87580	26	10.12420	9.90282	9	5
56	9.77879	17	9.87606	27	10.12394	9.90273	10	4
57	9.77896	17	9.87633	26	10.12367	9.90263	9	3
58	9.77913	17	9.87659	26	10.12341	9.90254	10	2
59	9.77930	16	9.87685	26	10.12315	9.90244	9	1
60	9.77946		9.87711		10.12289	9.90235		0
	Cof.		Cot.		Tang.	Sin.		

53 Degrees.

37 Degrees.

′	Sin.	D.	Tang.	D.	Cot.	Cof.	D.	′
0	9.77946	17	9.87711	27	10.12289	9.90235	10	60
1	9.77963	17	9.87738	26	10.12262	9.90225	9	59
2	9.77980	17	9.87764	26	10.12236	9.90216	10	58
3	9.77997	16	9.87790	27	10.12210	9.90206	9	57
4	9.78013	17	9.87817	26	10.12183	9.90197	10	56
5	9.78030	17	9.87843	26	10.12157	9.90187	9	55
6	9.78047	16	9.87869	26	10.12131	9.90178	10	54
7	9.78063	17	9.87895	27	10.12105	9.90168	9	53
8	9.78080	17	9.87922	26	10.12078	9.90159	10	52
9	9.78097	16	9.87948	26	10.12052	9.90149	10	51
10	9.78113	17	9.87974	26	10.12026	9.90139	9	50
11	9.78130	17	9.88000	27	10.12000	9.90130	10	49
12	9.78147	16	9.88027	26	10.11973	9.90120	9	48
13	9.78163	17	9.88053	26	10.11947	9.90111	10	47
14	9.78180	17	9.88079	26	10.11921	9.90101	10	46
15	9.78197	16	9.88105	26	10.11895	9.90091	9	45
16	9.78213	17	9.88131	27	10.11869	9.90082	10	44
17	9.78230	16	9.88158	26	10.11842	9.90072	9	43
18	9.78246	17	9.88184	26	10.11816	9.90063	10	42
19	9.78263	17	9.88210	26	10.11790	9.90053	10	41
20	9.78280	16	9.88236	26	10.11764	9.90043	9	40
21	9.78296	17	9.88262	27	10.11738	9.90034	10	39
22	9.78313	16	9.88289	26	10.11711	9.90024	10	38
23	9.78329	17	9.88315	26	10.11685	9.90014	9	37
24	9.78346	16	9.88341	26	10.11659	9.90005	10	36
25	9.78362	17	9.88367	26	10.11633	9.89995	10	35
26	9.78379	16	9.88393	27	10.11607	9.89985	9	34
27	9.78395	17	9.88420	26	10.11580	9.89976	10	33
28	9.78412	16	9.88446	26	10.11554	9.89966	10	32
29	9.78428	17	9.88472	26	10.11528	9.89956	9	31
30	9.78445	16	9.88498	26	10.11502	9.89947	10	30
31	9.78461	17	9.88524	26	10.11476	9.89937	10	29
32	9.78478	16	9.88550	27	10.11450	9.89927	9	28
33	9.78494	16	9.88577	26	10.11423	9.89918	10	27
34	9.78510	17	9.88603	26	10.11397	9.89908	10	26
35	9.78527	16	9.88629	26	10.11371	9.89898	10	25
36	9.78543	17	9.88655	26	10.11345	9.89888	9	24
37	9.78560	16	9.88681	26	10.11319	9.89879	10	23
38	9.78576	16	9.88707	26	10.11293	9.89869	10	22
39	9.78592	17	9.88733	26	10.11267	9.89859	10	21
40	9.78609	16	9.88759	27	10.11241	9.89849	9	20
41	9.78625	17	9.88786	26	10.11214	9.89840	10	19
42	9.78642	16	9.88812	26	10.11188	9.89830	10	18
43	9.78658	16	9.88838	26	10.11162	9.89820	10	17
44	9.78674	17	9.88864	26	10.11136	9.89810	9	16
45	9.78691	16	9.88890	26	10.11110	9.89801	10	15
46	9.78707	16	9.88916	26	10.11084	9.89791	10	14
47	9.78723	16	9.88942	26	10.11058	9.89781	10	13
48	9.78739	17	9.88968	26	10.11032	9.89771	10	12
49	9.78756	16	9.88994	26	10.11006	9.89761	9	11
50	9.78772	16	9.89020	26	10.10980	9.89752	10	10
51	9.78788	17	9.89046	27	10.10954	9.89742	10	9
52	9.78805	16	9.89073	26	10.10927	9.89732	10	8
53	9.78821	16	9.89099	26	10.10901	9.89722	10	7
54	9.78837	16	9.89125	26	10.10875	9.89712	10	6
55	9.78853	16	9.89151	26	10.10849	9.89702	9	5
56	9.78869	17	9.89177	26	10.10823	9.89693	10	4
57	9.78886	16	9.89203	26	10.10797	9.89683	10	3
58	9.78902	16	9.89229	26	10.10771	9.89673	10	2
59	9.78918	16	9.89255	26	10.10745	9.89663	10	1
60	9.78934		9.89281		10.10719	9.89653		0
	Cof.		Cot.		Tang.	Sin.		

52 Degrees.

38 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.78934	16	9.89281	26	10.10719	9.89653	10	60
1	9.78950	17	9.89307	26	10.10693	9.89643	10	59
2	9.78967	16	9.89333	26	10.10667	9.89633	9	58
3	9.78983	16	9.89359	26	10.10641	9.89624	10	57
4	9.78999	16	9.89385	26	10.10615	9.89614	10	56
5	9.79015	16	9.89411	26	10.10589	9.89604	10	55
6	9.79031	16	9.89437	26	10.10563	9.89594	10	54
7	9.79047	16	9.89463	26	10.10537	9.89584	10	53
8	9.79063	16	9.89489	26	10.10511	9.89574	10	52
9	9.79079	16	9.89515	26	10.10485	9.89564	10	51
10	9.79095	16	9.89541	26	10.10459	9.89554	10	50
11	9.79111	17	9.89567	26	10.10433	9.89544	10	49
12	9.79128	16	9.89593	26	10.10407	9.89534	10	48
13	9.79144	16	9.89619	26	10.10381	9.89524	10	47
14	9.79160	16	9.89645	26	10.10855	9.89514	10	46
15	9.79176	16	9.89671	26	10.10329	9.89504	9	45
16	9.79192	16	9.89697	26	10.10303	9.89495	10	44
17	9.79208	16	9.89723	26	10.10277	9.89485	10	43
18	9.79224	16	9.89749	26	10.10251	9.89475	10	42
19	9.79240	16	9.89775	26	10.10225	9.89465	10	41
20	9.79256	16	9.89801	26	10.10199	9.89455	10	40
21	9.79272	16	9.89827	26	10.10173	9.89445	10	39
22	9.79288	16	9.89853	26	10.10147	9.89435	10	38
23	9.79304	15	9.89879	26	10.10121	9.89425	10	37
24	9.79319	16	9.89905	26	10.10095	9.89415	10	36
25	9.79335	16	9.89931	26	10.10069	9.89405	10	35
26	9.79351	16	9.89957	26	10.10043	9.89395	10	34
27	9.79367	16	9.89983	26	10.10017	9.89385	10	33
28	9.79383	16	9.90009	26	10.09991	9.89375	11	32
29	9.79399	16	9.90035	26	10.09965	9.89364	10	31
30	9.79415	16	9.90061	25	10.09939	9.89354	10	30
31	9.79431	16	9.90086	26	10.09914	9.89344	10	29
32	9.79447	16	9.90112	26	10.09888	9.89334	10	28
33	9.79463	15	9.90138	26	10.09862	9.89324	10	27
34	9.79478	16	9.90164	26	10.09836	9.89314	10	26
35	9.79494	16	9.90190	26	10.09810	9.89304	10	25
36	9.79510	16	9.90216	26	10.09784	9.89294	10	24
37	9.79526	16	9.90242	26	10.09758	9.89284	10	23
38	9.79542	16	9.90268	26	10.09732	9.89274	10	22
39	9.79558	15	9.90294	26	10.09706	9.89264	10	21
40	9.79573	16	9.90320	26	10.09680	9.89254	10	20
41	9.79589	16	9.90346	25	10.09654	9.89244	11	19
42	9.79605	16	9.90371	26	10.09629	9.89233	10	18
43	9.79621	15	9.90397	26	10.09603	9.89223	10	17
44	9.79636	16	9.90423	26	10.09577	9.89213	10	16
45	9.79652	16	9.90449	26	10.09551	9.89203	10	15
46	9.79668	16	9.90475	26	10.09525	9.89193	10	14
47	9.79684	15	9.90501	26	10.09499	9.89183	10	13
48	9.79699	16	9.90527	26	10.09473	9.89173	11	12
49	9.79715	16	9.90553	25	10.09447	9.89162	10	11
50	9.79731	15	9.90578	26	10.09422	9.89152	10	10
51	9.79746	16	9.90604	26	10.09396	9.89142	10	9
52	9.79762	16	9.90630	26	10.09370	9.89132	10	8
53	9.79778	15	9.90656	26	10.09344	9.89122	10	7
54	9.79793	16	9.90682	26	10.09318	9.89112	11	6
55	9.79809	16	9.90708	26	10.09292	9.89101	10	5
56	9.79825	15	9.90734	25	10.09266	9.89091	10	4
57	9.79840	16	9.90759	26	10.09241	9.89081	10	3
58	9.79856	16	9.90785	26	10.09215	9.89071	11	2
59	9.79872	15	9.90811	26	10.09189	9.89060	10	1
60	9.79887		9.90837		10.09163	9.89050		0
	Cos.		Cot.		Tang.	Sin.		
51 Degrees.								

39 Degrees.								
′	Sin.	D	Tang.	D.	Cot.	Cos.	D.	′
0	9.79887	16	9.90837	26	10.09163	9.89050	10	60
1	9.79903	15	9.90863	26	10.09137	9.89040	10	59
2	9.79918	16	9.90889	25	10.09111	9.89030	10	58
3	9.79934	16	9.90914	26	10.09086	9.89020	11	57
4	9.79950	15	9.90940	26	10.09060	9.89009	10	56
5	9.79965	16	9.90966	26	10.09034	9.88999	10	55
6	9.79981	15	9.90992	26	10.09008	9.88989	11	54
7	9.79996	16	9.91018	25	10.08982	9.88978	10	53
8	9.80012	15	9.91043	26	10.08957	9.88968	10	52
9	9.80027	16	9.91069	26	10.08931	9.88958	10	51
10	9.80043	15	9.91095	26	10.08905	9.88948	11	50
11	9.80058	16	9.91121	26	10.08879	9.88937	10	49
12	9.80074	15	9.91147	25	10.08853	9.88927	10	48
13	9.80089	16	9.91172	26	10.08828	9.88917	11	47
14	9.80105	15	9.91198	26	10.08802	9.88906	10	46
15	9.80120	16	9.91224	26	10.08776	9.88896	10	45
16	9.80136	15	9.91250	26	10.08750	9.88886	11	44
17	9.80151	15	9.91276	25	10.08724	9.88875	10	43
18	9.80166	16	9.91301	26	10.08699	9.88865	10	42
19	9.80182	15	9.91327	26	10.08673	9.88855	11	41
20	9.80197	16	9.91353	26	10.08647	9.88844	10	40
21	9.80213	15	9.91379	25	10.08621	9.88834	10	39
22	9.80228	16	9.91404	26	10.08596	9.88824	11	38
23	9.80244	15	9.91430	26	10.08570	9.88813	10	37
24	9.80259	15	9.91456	26	10.08544	9.88803	10	36
25	9.80274	16	9.91482	25	10.08518	9.88793	11	35
26	9.80290	15	9.91507	26	10.08493	9.88782	10	34
27	9.80305	15	9.91533	26	10.08467	9.88772	11	33
28	9.80320	16	9.91559	26	10.08441	9.88761	10	32
29	9.80336	15	9.91585	25	10.08415	9.88751	10	31
30	9.80351	15	9.91610	26	10.08390	9.88741	11	30
31	9.80366	16	9.91636	26	10.08364	9.88730	10	29
32	9.80382	15	9.91662	26	10.08338	9.88720	11	28
33	9.80397	15	9.91688	25	10.08312	9.88709	10	27
34	9.80412	16	9.91713	26	10.08287	9.88699	11	26
35	9.80428	15	9.91739	26	10.08261	9.88688	10	25
36	9.80443	15	9.91765	26	10.08235	9.88678	11	24
37	9.80458	15	9.91791	25	10.08209	9.88667	10	23
38	9.80473	16	9.91816	26	10.08184	9.88657	10	22
39	9.80489	15	9.91842	26	10.08158	9.88647	11	21
40	9.80504	15	9.91868	25	10.08132	9.88636	10	20
41	9.80519	15	9.91893	26	10.08107	9.88626	11	19
42	9.80534	16	9.91919	26	10.08081	9.88615	10	18
43	9.80550	15	9.91945	26	10.08055	9.88605	11	17
44	9.80565	15	9.91971	25	10.08029	9.88594	10	16
45	9.80580	15	9.91996	26	10.08004	9.88584	11	15
46	9.80595	15	9.92022	26	10.07978	9.88573	10	14
47	9.80610	15	9.92048	25	10.07952	9.88563	11	13
48	9.80625	16	9.92073	26	10.07927	9.88552	10	12
49	9.80641	15	9.92099	26	10.07901	9.88542	11	11
50	9.80656	15	9.92125	25	10.07875	9.88531	10	10
51	9.80671	15	9.92150	26	10.07850	9.88521	11	9
52	9.80686	15	9.92176	26	10.07824	9.88510	11	8
53	9.80701	15	9.92202	25	10.07798	9.88499	10	7
54	9.80716	15	9.92227	26	10.07773	9.88489	11	6
55	9.80731	15	9.92253	26	10.07747	9.88478	10	5
56	9.80746	16	9.92279	25	10.07721	9.88468	11	4
57	9.80762	15	9.92304	26	10.07696	9.88457	10	3
58	9.80777	15	9.92330	26	10.07670	9.88447	11	2
59	9.80792	15	9.92356	25	10.07644	9.88436	11	1
60	9.80807		9.92381		10.07619	9.88425		0
	Cos.		Cot.		Tang.	Sin.		
50 Degrees.								

40 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.80807	15	9.92381	26	10.07619	9.88425	10	60
1	9.80822	15	9.92407	26	10.07593	9.88415	11	59
2	9.80837	15	9.92433	25	10.07567	9.88404	10	58
3	9.80852	15	9.92458	26	10.07542	9.88394	11	57
4	9.80867	15	9.92484	26	10.07516	9.88383	11	56
5	9.80882	15	9.92510	25	10.07490	9.88372	10	55
6	9.80897	15	9.92535	26	10.07465	9.88362	11	54
7	9.80912	15	9.92561	26	10.07439	9.88351	11	53
8	9.80927	15	9.92587	25	10.07413	9.88340	10	52
9	9.80942	15	9.92612	26	10.07388	9.88330	11	51
10	9.80957	15	9.92638	25	10.07362	9.88319	11	50
11	9.80972	15	9.92663	26	10.07337	9.88308	10	49
12	9.80987	15	9.92689	26	10.07311	9.88298	11	48
13	9.81002	15	9.92715	25	10.07285	9.88287	11	47
14	9.81017	15	9.92740	26	10.07260	9.88276	10	46
15	9.81032	15	9.92766	26	10.07234	9.88266	11	45
16	9.81047	14	9.92792	25	10.07208	9.88255	11	44
17	9.81061	15	9.92817	26	10.07183	9.88244	10	43
18	9.81076	15	9.92843	25	10.07157	9.88234	11	42
19	9.81091	15	9.92868	26	10.07132	9.88223	11	41
20	9.81106	15	9.92894	26	10.07106	9.88212	11	40
21	9.81121	15	9.92920	25	10.07080	9.88201	10	39
22	9.81136	15	9.92945	26	10.07055	9.88191	11	38
23	9.81151	15	9.92971	25	10.07029	9.88180	11	37
24	9.81166	14	9.92996	26	10.07004	9.88169	11	36
25	9.81180	15	9.93022	26	10.06978	9.88158	10	35
26	9.81195	15	9.93048	25	10.06952	9.88148	11	34
27	9.81210	15	9.93073	26	10.06927	9.88137	11	33
28	9.81225	15	9.93099	25	10.06901	9.88126	11	32
29	9.81240	14	9.93124	26	10.06876	9.88115	10	31
30	9.81254	15	9.93150	25	10.06850	9.88105	11	30
31	9.81269	15	9.93175	26	10.06825	9.88094	11	29
32	9.81284	15	9.93201	26	10.06799	9.88083	11	28
33	9.81299	15	9.93227	25	10.06773	9.88072	11	27
34	9.81314	14	9.93252	26	10.06748	9.88061	10	26
35	9.81328	15	9.93278	25	10.06722	9.88051	11	25
36	9.81343	15	9.93303	26	10.06697	9.88040	11	24
37	9.81358	14	9.93329	25	10.06671	9.88029	11	23
38	9.81372	15	9.93354	26	10.06646	9.88018	11	22
39	9.81387	15	9.93380	26	10.06620	9.88007	11	21
40	9.81402	15	9.93406	25	10.06594	9.87996	11	20
41	9.81417	14	9.93431	26	10.06569	9.87985	10	19
42	9.81431	15	9.93457	25	10.06543	9.87975	11	18
43	9.81446	15	9.93482	26	10.06518	9.87964	11	17
44	9.81461	14	9.93508	25	10.06492	9.87953	11	16
45	9.81475	15	9.93533	26	10.06467	9.87942	11	15
46	9.81490	15	9.93559	25	10.06441	9.87931	11	14
47	9.81505	14	9.93584	26	10.06416	9.87920	11	13
48	9.81519	15	9.93610	26	10.06390	9.87909	11	12
49	9.81534	15	9.93636	25	10.06364	9.87898	11	11
50	9.81549	14	9.93661	26	10.06339	9.87887	10	10
51	9.81563	15	9.93687	25	10.06313	9.87877	11	9
52	9.81578	14	9.93712	26	10.06288	9.87866	11	8
53	9.81592	15	9.93738	25	10.06262	9.87855	11	7
54	9.81607	15	9.93763	26	10.06237	9.87844	11	6
55	9.81622	14	9.93789	25	10.06211	9.87833	11	5
56	9.81636	15	9.93814	26	10.06186	9.87822	11	4
57	9.81651	14	9.93840	25	10.06160	9.87811	11	3
58	9.81665	15	9.93865	26	10.06135	9.87800	11	2
59	9.81680	14	9.93891	25	10.06109	9.87789	11	1
60	9.81694		9.93916		10.06084	9.87778		0
	Cos.		Cot.		Tang.	Sin.		
49 Degrees.								

41 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.81694	15	9.93916	26	10.06084	9.87778	11	60
1	9.81709	14	9.93942	25	10.06058	9.87767	11	59
2	9.81723	15	9.93967	26	10.06033	9.87756	11	58
3	9.81738	14	9.93993	25	10.06007	9.87745	11	57
4	9.81752	15	9.94018	26	10.05982	9.87734	11	56
5	9.81767	14	9.94044	25	10.05956	9.87723	11	55
6	9.81781	15	9.94069	26	10.05931	9.87712	11	54
7	9.81796	14	9.94095	25	10.05905	9.87701	11	53
8	9.81810	15	9.94120	26	10.05880	9.87690	11	52
9	9.81825	14	9.94146	25	10.05854	9.87679	11	51
10	9.81839	15	9.94171	26	10.05829	9.87668	11	50
11	9.81854	14	9.94197	25	10.05803	9.87657	11	49
12	9.81868	14	9.94222	26	10.05778	9.87646	11	48
13	9.81882	15	9.94248	25	10.05752	9.87635	11	47
14	9.81897	14	9.94273	26	10.05727	9.87624	11	46
15	9.81911	15	9.94299	25	10.05701	9.87613	12	45
16	9.81926	14	9.94324	26	10.05676	9.87601	11	44
17	9.81940	15	9.94350	25	10.05650	9.87590	11	43
18	9.81955	14	9.94375	26	10.05625	9.87579	11	42
19	9.81969	14	9.94401	25	10.05599	9.87568	11	41
20	9.81983	15	9.94426	26	10.05574	9.87557	11	40
21	9.81998	14	9.94452	25	10.05548	9.87546	11	39
22	9.82012	14	9.94477	26	10.05523	9.87535	11	38
23	9.82026	15	9.94503	25	10.05497	9.87524	11	37
24	9.82041	14	9.94528	26	10.05472	9.87513	12	36
25	9.82055	14	9.94554	25	10.05446	9.87501	11	35
26	9.82069	15	9.94579	25	10.05421	9.87490	11	34
27	9.82084	14	9.94604	26	10.05396	9.87479	11	33
28	9.82098	14	9.94630	25	10.05370	9.87468	11	32
29	9.82112	14	9.94655	26	10.05345	9.87457	11	31
30	9.82126	15	9.94681	25	10.05319	9.87446	12	30
31	9.82141	14	9.94706	26	10.05294	9.87434	11	29
32	9.82155	14	9.94732	25	10.05268	9.87423	11	28
33	9.82169	15	9.94757	26	10.05243	9.87412	11	27
34	9.82184	14	9.94783	25	10.05217	9.87401	11	26
35	9.82198	14	9.94808	26	10.05192	9.87390	12	25
36	9.82212	14	9.94834	25	10.05166	9.87378	11	24
37	9.82226	14	9.94859	25	10.05141	9.87367	11	23
38	9.82240	15	9.94884	26	10.05116	9.87356	11	22
39	9.82255	14	9.94910	25	10.05090	9.87345	11	21
40	9.82269	14	9.94935	26	10.05065	9.87334	12	20
41	9.82283	14	9.94961	25	10.05039	9.87322	11	19
42	9.82297	14	9.94986	26	10.05014	9.87311	11	18
43	9.82311	15	9.95012	25	10.04988	9.87300	12	17
44	9.82326	14	9.95037	25	10.04963	9.87288	11	16
45	9.82340	14	9.95062	26	10.04938	9.87277	11	15
46	9.82354	14	9.95088	25	10.04912	9.87266	11	14
47	9.82368	14	9.95113	26	10.04887	9.87255	12	13
48	9.82382	14	9.95138	25	10.04861	9.87243	11	12
49	9.82396	14	9.95164	26	10.04836	9.87232	11	11
50	9.82410	14	9.95190	25	10.04810	9.87221	12	10
51	9.82424	15	9.95215	25	10.04785	9.87209	11	9
52	9.82439	14	9.95240	26	10.04760	9.87198	11	8
53	9.82453	14	9.95266	25	10.04734	9.87187	12	7
54	9.82467	14	9.95291	26	10.04709	9.87175	11	6
55	9.82481	14	9.95317	25	10.04683	9.87164	11	5
56	9.82495	14	9.95342	26	10.04658	9.87153	12	4
57	9.82509	14	9.95368	25	10.04632	9.87141	11	3
58	9.82523	14	9.95393	25	10.04607	9.87130	11	2
59	9.82537	14	9.95418	26	10.04582	9.87119	12	1
60	9.82551		9.95444		10.04556	9.87107		0
	Cos.		Cot.		Tang.	Sin.		
48 Degrees.								

42 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.82551	14	9.95444	25	10.04556	9.87107	11	60
1	9.82565	14	9.95469	26	10.04531	9.87096	11	59
2	9.82579	14	9.95495	25	10.04505	9.87085	12	58
3	9.82593	14	9.95520	25	10.04480	9.87073	11	57
4	9.82607	14	9.95545	26	10.04455	9.87062	12	56
5	9.82621	14	9.95571	25	10.04429	9.87050	11	55
6	9.82635	14	9.95596	26	10.04404	9.87039	11	54
7	9.82649	14	9.95622	25	10.04378	9.87028	12	53
8	9.82663	14	9.95647	25	10.04353	9.87016	11	52
9	9.82677	14	9.95672	26	10.04328	9.87005	12	51
10	9.82691	14	9.95698	25	10.04202	9.86993	11	50
11	9.82705	14	9.95723	25	10.04277	9.86982	12	49
12	9.82719	14	9.95748	26	10.04252	9.86970	11	48
13	9.82733	14	9.95774	25	10.04226	9.86959	12	47
14	9.82747	14	9.95799	26	10.04201	9.86947	11	46
15	9.82761	14	9.95825	25	10.04175	9.86936	12	45
16	9.82775	13	9.95850	25	10.04150	9.86924	11	44
17	9.82788	14	9.95875	26	10.04125	9.86913	11	43
18	9.82802	14	9.95901	25	10.04099	9.86902	12	42
19	9.82816	14	9.95926	26	10.04074	9.86890	11	41
20	9.82830	14	9.95952	25	10.04048	9.86879	12	40
21	9.82844	14	9.95977	25	10.04023	9.86867	12	39
22	9.82858	14	9.96002	26	10.03998	9.86855	11	38
23	9.82872	13	9.96028	25	10.03972	9.86844	12	37
24	9.82885	14	9.96053	25	10.03947	9.86832	11	36
25	9.82899	14	9.96078	26	10.03922	9.86821	12	35
26	9.82913	14	9.96104	25	10.03896	9.86809	11	34
27	9.82927	14	9.96129	26	10.03871	9.86798	12	33
28	9.82941	14	9.96155	25	10.03845	9.86786	11	32
29	9.82955	13	9.96180	25	10.03820	9.86775	12	31
30	9.82968	14	9.96205	26	10.03795	9.86763	11	30
31	9.82982	14	9.96231	25	10.03769	9.86752	12	29
32	9.82996	14	9.96256	25	10.03744	9.86740	12	28
33	9.83010	13	9.96281	26	10.03719	9.86728	11	27
34	9.83023	14	9.96307	25	10.03693	9.86717	12	26
35	9.83037	14	9.96332	25	10.03668	9.86705	11	25
36	9.83051	14	9.96357	26	10.03643	9.86694	12	24
37	9.83065	13	9.96383	25	10.03617	9.86682	12	23
38	9.83078	14	9.96408	25	10.03592	9.86670	11	22
39	9.83092	14	9.96433	26	10.03567	9.86659	12	21
40	9.83106	14	9.96459	25	10.03541	9.86647	12	20
41	9.83120	13	9.96484	26	10.03516	9.86635	11	19
42	9.83133	14	9.96510	25	10.03490	9.86624	12	18
43	9.83147	14	9.96535	25	10.03465	9.86612	12	17
44	9.83161	13	9.96560	26	10.03440	9.86600	11	16
45	9.83174	14	9.96586	25	10.03414	9.86589	12	15
46	9.83188	14	9.96611	25	10.03389	9.86577	12	14
47	9.83202	13	9.96636	26	10.03364	9.86565	11	13
48	9.83215	14	9.96662	25	10.03338	9.86554	12	12
49	9.83229	13	9.96687	25	10.03313	9.86542	12	11
50	9.83242	14	9.96712	26	10.03288	9.86530	12	10
51	9.83256	14	9.96738	25	10.03262	9.86518	11	9
52	9.83270	13	9.96763	25	10.03237	9.86507	12	8
53	9.83283	14	9.96788	26	10.03212	9.86495	12	7
54	9.83297	13	9.96814	25	10.03186	9.86483	11	6
55	9.83310	14	9.96839	25	10.03161	9.86472	12	5
56	9.83324	14	9.96864	26	10.03136	9.86460	12	4
57	9.83338	13	9.96890	25	10.03110	9.86448	12	3
58	9.83351	14	9.96915	25	10.03085	9.86436	11	2
59	9.83365	13	9.96940	26	10.03060	9.86425	12	1
60	9.83378		9.96966		10.03034	9.86413		0
	Cos.		Cot.		Tang.	Sin.		
47 Degrees.								

43 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.83378	14	9.96966	25	10.03034	9.86413	12	60
1	9.83392	13	9.96991	25	10.03009	9.86401	12	59
2	9.83405	14	9.97016	26	10.02984	9.86389	12	58
3	9.83419	13	9.97042	25	10.02958	9.86377	11	57
4	9.83432	14	9.97067	25	10.02933	9.86366	12	56
5	9.83446	13	9.97092	26	10.02908	9.86354	12	55
6	9.83459	14	9.97118	25	10.02882	9.86342	12	54
7	9.83473	13	9.97143	25	10.02857	9.86330	12	53
8	9.83486	14	9.97168	25	10.02832	9.86318	12	52
9	9.83500	13	9.97193	26	10.02807	9.86306	11	51
10	9.83513	14	9.97219	25	10.02781	9.86295	12	50
11	9.83527	13	9.97244	25	10.02756	9.86283	12	49
12	9.83540	14	9.97269	26	10.02731	9.86271	12	48
13	9.83554	13	9.97295	25	10.02705	9.86259	12	47
14	9.83567	14	9.97320	25	10.02680	9.86247	12	46
15	9.83581	13	9.97345	26	10.02655	9.86235	12	45
16	9.83594	14	9.97371	25	10.02629	9.86223	12	44
17	9.83608	13	9.97396	25	10.02604	9.86211	11	43
18	9.83621	13	9.97421	26	10.02579	9.86200	12	42
19	9.83634	14	9.97447	25	10.02553	9.86188	12	41
20	9.83648	13	9.97472	25	10.02528	9.86176	12	40
21	9.83661	13	9.97497	26	10.02503	9.86164	12	39
22	9.83674	14	9.97523	25	10.02477	9.86152	12	38
23	9.83688	13	9.97548	25	10.02452	9.86140	12	37
24	9.83701	14	9.97573	25	10.02427	9.86128	12	36
25	9.83715	13	9.97598	26	10.02402	9.86116	12	35
26	9.83728	13	9.97624	25	10.02376	9.86104	12	34
27	9.83741	14	9.97649	25	10.02351	9.86092	12	33
28	9.83755	13	9.97674	26	10.02326	9.86080	12	32
29	9.83768	13	9.97700	25	10.02300	9.86068	12	31
30	9.83781	14	9.97725	25	10.02275	9.86056	12	30
31	9.83795	13	9.97750	26	10.02250	9.86044	12	29
32	9.83808	13	9.97776	25	10.02224	9.86032	12	28
33	9.83821	13	9.97801	25	10.02199	9.86020	12	27
34	9.83834	14	9.97826	25	10.02174	9.86008	12	26
35	9.83848	13	9.97851	26	10.02149	9.85996	12	25
36	9.83861	13	9.97877	25	10.02123	9.85984	12	24
37	9.83874	13	9.97902	25	10.02098	9.85972	12	23
38	9.83887	14	9.97927	26	10.02073	9.85960	12	22
39	9.83901	13	9.97953	25	10.02047	9.85948	12	21
40	9.83914	13	9.97978	25	10.02022	9.85936	12	20
41	9.83927	13	9.98003	26	10.01997	9.85924	12	19
42	9.83940	14	9.98029	25	10.01971	9.85912	12	18
43	9.83954	13	9.98054	25	10.01946	9.85900	12	17
44	9.83967	13	9.98079	25	10.01921	9.85888	12	16
45	9.83980	13	9.98104	26	10.01896	9.85876	12	15
46	9.83993	13	9.98130	25	10.01870	9.85864	13	14
47	9.84006	14	9.98155	25	10.01845	9.85851	12	13
48	9.84020	13	9.98180	26	10.01820	9.85839	12	12
49	9.84033	13	9.98206	25	10.01794	9.85827	12	11
50	9.84046	13	9.98231	25	10.01769	9.85815	12	10
51	9.84059	13	9.98256	25	10.01744	9.85803	12	9
52	9.84072	13	9.98281	26	10.01719	9.85791	12	8
53	9.84085	13	9.98307	25	10.01693	9.85779	13	7
54	9.84098	14	9.98332	25	10.01668	9.85766	12	6
55	9.84112	13	9.98357	26	10.01643	9.85754	12	5
56	9.84125	13	9.98383	25	10.01617	9.85742	12	4
57	9.84138	13	9.98408	25	10.01592	9.85730	12	3
58	9.84151	13	9.98433	25	10.01567	9.85718	12	2
59	9.84164	13	9.98458	26	10.01542	9.85706	13	1
60	9.84177		9.98484		10.01516	9.85693		0
	Cos.		Cot.		Tang.	Sin.		
46 Degrees.								

44 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
0	9.84177	13	9.98484	25	10.01516	9.85693	12	60
1	9.84190	13	9.98509	25	10.01491	9.85681	12	59
2	9.84203	13	9.98534	26	10.01466	9.85669	12	58
3	9.84216	13	9.98560	25	10.01440	9.85657	12	57
4	9.84229	13	9.98585	25	10.01415	9.85645	13	56
5	9.84242	13	9.98610	25	10.01390	9.85632	12	55
6	9.84255	14	9.98635	26	10.01365	9.85620	12	54
7	9.84269	13	9.98661	25	10.01339	9.85608	12	53
8	9.84282	13	9.98686	25	10.01314	9.85596	13	52
9	9.84295	13	9.98711	26	10.01289	9.85583	12	51
10	9.84308	13	9.98737	25	10.01263	9.85571	12	50
11	9.84321	13	9.98762	25	10.01238	9.85559	12	49
12	9.84334	13	9.98787	25	10.01213	9.85547	13	48
13	9.84347	13	9.98812	26	10.01188	9.85534	12	47
14	9.84360	13	9.98838	25	10.01162	9.85522	12	46
15	9.84373	12	9.98863	25	10.01137	9.85510	13	45
16	9.84385	13	9.98888	25	10.01112	9.85497	12	44
17	9.84398	13	9.98913	26	10.01087	9.85485	12	43
18	9.84411	13	9.98939	25	10.01061	9.85473	13	42
19	9.84424	13	9.98964	25	10.01036	9.85460	12	41
20	9.84437	13	9.98989	26	10.01011	9.85448	12	40
21	9.84450	13	9.99015	25	10.00985	9.85436	13	39
22	9.84463	13	9.99040	25	10.00960	9.85423	12	38
23	9.84476	13	9.99065	25	10.00935	9.85411	12	37
24	9.84489	13	9.99090	26	10.00910	9.85399	13	36
25	9.84502	13	9.99116	25	10.00884	9.85386	12	35
26	9.84515	13	9.99141	25	10.00859	9.85374	13	34
27	9.84528	12	9.99166	25	10.00834	9.85361	12	33
28	9.84540	13	9.99191	26	10.00809	9.85349	12	32
29	9.84553	13	9.99217	25	10.00783	9.85337	13	31
30	9.84566		9.99242		10.00758	9.85324		30
	Cos.		Cot.		Tang.	Sin.		
45 Degrees.								

44 Degrees.								
′	Sin.	D.	Tang.	D.	Cot.	Cos.	D.	′
30	9.84566	13	9.99242	25	10.00758	9.85324	12	30
31	9.84579	13	9.99267	26	10.00733	9.85312	13	29
32	9.84592	13	9.99293	25	10.00707	9.85299	12	28
33	9.84605	13	9.99318	25	10.00682	9.85287	13	27
34	9.84618	12	9.99343	25	10.00657	9.85274	12	26
35	9.84630	13	9.99368	26	10.00632	9.85262	12	25
36	9.84643	13	9.99394	25	10.00606	9.85250	13	24
37	9.84656	13	9.99419	25	10.00581	9.85237	12	23
38	9.84669	13	9.99444	25	10.00556	9.85225	13	22
39	9.84682	12	9.99469	26	10.00531	9.85212	12	21
40	9.84694	13	9.99495	25	10.00505	9.85200	13	20
41	9.84707	13	9.99520	25	10.00480	9.85187	12	19
42	9.84720	13	9.99545	25	10.00455	9.85175	13	18
43	9.84733	12	9.99570	26	10.00430	9.85162	12	17
44	9.84745	13	9.99596	25	10.00404	9.85150	13	16
45	9.84758	13	9.99621	25	10.00379	9.85137	12	15
46	9.84771	13	9.99646	26	10.00354	9.85125	13	14
47	9.84784	12	9.99672	25	10.00328	9.85112	12	13
48	9.84796	13	9.99697	25	10.00303	9.85100	13	12
49	9.84809	13	9.99722	25	10.00278	9.85087	13	11
50	9.84822	13	9.99747	26	10.00253	9.85074	12	10
51	9.84835	12	9.99773	25	10.00227	9.85062	13	9
52	9.84847	13	9.99798	25	10.00202	9.85049	12	8
53	9.84860	13	9.99823	25	10.00177	9.85037	13	7
54	9.84873	12	9.99848	26	10.00152	9.85024	12	6
55	9.84885	13	9.99874	25	10.00126	9.85012	13	5
56	9.84898	13	9.99899	25	10.00101	9.84999	13	4
57	9.84911	12	9.99924	25	10.00076	9.84986	12	3
58	9.84923	13	9.99949	26	10.00051	9.84974	13	2
59	9.84936	13	9.99975	25	10.00025	9.84961	12	1
60	9.84949		0.00000		10.00000	9.84949		0
	Cos.		Cot.		Tang.	Sin.		
45 Degrees.								

Logarithmic curve. Plate CCXCVII. fig. 3.

LOGARITHMIC CURVE. If on the line AN both ways indefinitely extended, be taken AC, CE, EG, GI, IL, on the left hand; and also A *g*, *g* P, &c. on the right, all equal to one another; and if at the points P*g*, A, C, E, G, I, L, be erected to the right line AN, the perpendiculars PS, *g d*, AB, CD, EF, GH, IK, LM, which let be continually proportional, and represent numbers, viz. AB, 1; CD, 10; EF, 100, &c. then shall we have two progressions of lines, arithmetical and geometrical: for the lines AC, AE, AG, &c. are in arithmetical progression, or as 1, 2, 3, 4, 5, &c. and so represent the logarithms to which the geometrical lines AB, CD, EF, &c. do correspond. For since AG is triple of the first line AC, the number GH shall be in the third place from unity, if CD be in the first: so likewise shall LM be in the fifth place, since AL=5 AC. If the extremities of the proportionals S, *d*, B, D, F, &c. be joined by right lines, the figures SBML will become a polygon, consisting of more or less sides, according as there are more or less terms in the progression.

If the parts AC, CE, EG, &c. be bisected in the points *c*, *e*, *g*, *i*, *l*, and there be again raised the perpendiculars, *c d*, *e f*, *g h*, *i k*, *l m*, which are mean proportionals between AB, CD, CD, EF, &c. then there will arise a new series of proportionals whose terms, beginning from that which immediately follows unity, are double of those in the first series, and the difference of the terms is become less, and approaches nearer to a ratio of equality than before. Likewise, in this new series, the right lines AL, A *c*, express the distances of the terms LM *c d*, from unity, viz. since AL is ten times greater than A *c*, LM shall be the tenth term of the series from unity; and because A *e* is three times greater than A *c*, *e f* will be the third term of the series if *c d* be the first, and there shall be two mean proportionals between AB and *e f*, and between AB and LM there will be nine mean proportionals. And if the extremities of the lines B *d*, D *f*, F *h*, &c. be joined by right lines, there will be a new polygon made, consisting of more but shorter sides than the last.

Logarithmic curve.

If, in this manner, mean proportionals be continually placed between every two terms, the number of terms at last will be made so great, as also the number of the sides of the polygon, as to be greater than any given number, or to be infinite; and every side of the polygon so lessened, as to become less than any given right line; and consequently the polygon will be changed into a curve-lined figure; for any curve-lined figure may be conceived as a polygon, whose sides are infinitely

Logarithmic Lines.

infinitely ſmall and infinite in number. A curve deſcribed after this manner is called *logarithmical.*

It is manifeſt from this deſcription of the logarithmic curve, that all numbers at equal diſtances are continually proportional. It is alſo plain, that if there be four numbers, AB, CD, IK, LM, ſuch that the diſtance between the firſt and ſecond be equal to the diſtance between the third and the fourth, let the diſtance from the ſecond to the third be what it will, theſe numbers will be proportional. For becauſe the diſtances AC, IL, are equal, AB ſhall be to the increment D*s*, as IK is to the increment MT. Wherefore, by compoſition, AB : DC : : IK : ML. And, contrariwiſe, if four numbers be proportional, the diſtance between the firſt and ſecond ſhall be equal to the diſtance between the third and fourth.

The diſtance between any two numbers is called *the logarithm of the ratio of thoſe numbers;* and, indeed, doth not meaſure the ratio itſelf, but the number of terms in a given ſeries of geometrical proportionals, proceeding from one number to another, and defines the number of equal ratios by the compoſition whereof the ratios of number is known.

Logarithmic Lines. For many mechanical purpoſes it is convenient to have the logarithms of numbers laid down on ſcales, as well as the logarithmic ſines and tangents; by which means computations may be carried on by mere menſuration with compaſſes. Lines of this kind are always put on the common Gunter's ſcale; but as theſe inſtruments muſt be extended to a very great length, in order to contain any conſiderable quantity of numbers, it becomes on object of importance to ſhorten them. Such an improvement has been made by Mr William Nicholſon, and publiſhed in the 77th volume of the Philoſophical Tranſactions. The principles on which the conſtruction of his inſtruments depends are as follow:

1. If two geometrical ſeries of numbers, having the ſame common ratio, be placed in order with the terms oppoſite to each other, the ratio between any term in one ſeries and its oppoſite in the other will be conſtant: Thus,

2 6 18 54 162, &c.
3 9 27 81 243, &c. Then,
2 3 6 9 18 27 54 81 162 243, &c.

where it is evident, that each of the terms in the upper ſeries is exactly two-thirds of the correſponding one in the lower.

2. The ratio of any two terms in one ſeries will be the ſame with that between thoſe which have an equal diſtance in the other.

3. In all ſuch geometrical ſeries as have the ſame ratio, the property above mentioned takes place, though we compare the terms of any ſeries with thoſe of another: Thus,

$\begin{cases} 2 \ 4 \ 8 \ 16 \ 32 \ 64, \&c. \\ 3 \ 6 \ 12 \ 24 \ 48 \ 96, \&c. \end{cases}$
$\begin{cases} 4 \ 8 \ 16 \ 32 \ 64 \ 128, \&c. \\ 5 \ 10 \ 20 \ 40 \ 80 \ 160, \&c.; \end{cases}$ where it is plain that 2, 4, 3, 6; alſo 2, 4, 4, 8, and 2, 4, 5, 10, &c. have the ſame ratio with that of each ſeries.

4. If the differences of the logarithms of the numbers be laid in order upon equidiſtant parallel right lines, in ſuch a manner that a right line drawn acroſs the whole ſhall interſect it at diviſions denoting numbers in geometrical progreſſion; then, from the condition of the arrangement, and the property of this logarithmic line, it follows, 1ſt, That every right line ſo drawn will, by its interſections, indicate a geometrical ſeries of numbers; 2dly, That ſuch ſeries as are indicated by theſe right lines will have the ſame common ratio; and, 3dly, That the ſeries thus indicated by two parallel right lines, ſuppoſed to move laterally, without changing either their mutual diſtance or paralleliſm to themſelves, will have each the ſame ratio and in all ſeries indicated by ſuch two lines, the ratio between an antecedent and conſequent; the former taken upon one line, and the latter upon another, will be alſo the ſame.

Plate CCXCVII. Fig. 11.

The 1ſt of theſe propoſitions is proved in the following manner. Let the lines AB, CD, EF, repreſent parts of the logarithmic line arranged according to the proportion already mentioned; and let GH be a right line paſſing through the points *e*, *c*, *a*, denoting numbers in geometrical progreſſion; then will any other line IK, drawn acroſs the arrangement, likewiſe paſs through three points *f*, *d*, *b*, in geometrical progreſſion. From one of the points of interſection *f* in the laſt-mentioned line IK, draw the line *fg* parallel to GH, and interſecting the arrangement in the points *i*, *h;* and the ratios of the numbers *e*, *f c i*, will be equal, as well as of *a h;* becauſe the intervals on the logarithmic line, or differences of the logarithms of thoſe numbers, are equal. Again, The point *f*, the line *i d*, and the line *hb*, are in arithmetical progreſſion denoting the differences between the logarithms of the numbers themſelves; whence the quotients of the numbers are in geometrical progreſſion.

The 2d propoſition is proved in a ſimilar manner. For as it was ſhown that the line *fg*, parallel to GH, paſſes through points of diviſion denoting numbers in the ſame continued ratio as thoſe indicated by the line GH; it may alſo be ſhown, that the line LM parallel to any other line IK, will paſs through a ſeries of points denoting numbers which have the ſame continued ratio with thoſe indicated by the line IK, to which it is parallel.

The 3d propoſition ariſes from the paralleliſm of the lines to their former ſituation; by which means they indicate numbers in a geometrical ſeries, having the ſame common ratio as before: their diſtance on the logarithmic line alſo remains unchanged; whence the differences between the logarithms of the oppoſite numbers, and of conſequence their ratios, will always be conſtant.

5. Suppoſing now an antecedent and conſequent to be given in any geometrical ſeries, it will always be poſſible to find them, provided the line be of unlimited length. Drawing two parallel lines, then, through each of the numbers, and ſuppoſing the lines to move without changing their direction or parallel ſituation, they will continually deſcribe new antecedents and conſequents in the ſame geometrical ſeries as before.

6. Though the logarithmic line contain no greater range of numbers than from 1 to 10, it will not be found neceſſary for the purpoſes of computation to repeat it. The only thing requiſite is to have a ſlider or beam with two fixed points at the diſtance of the interval betwixt 1 and 10, and a moveable point made to range betwixt them always to indicate the antecedent; then, if the conſequent fixed point fall without

Logarithmic Lines.

out the rule, the other fixed point will always denote the diviſion on which it would have fallen had the rule been prolonged; and this contrivance may eaſily be adapted to any arrangement of parallel lines whatever. The arrangement of right lines, however, ought always to be diſpoſed in ſuch a manner as to occupy a right-angled parallelogram, or the croſs line already mentioned ought always to be at right angles to the length of the ruler.

Fig. 7. is a ruler conſiſting of ten parallel lines.—Fig. 8. a beam-compaſs for meaſuring the intervals. B, A, C, are the parts which apply to the ſurface of the ruler; the middle one, A, being moveable ſidewiſe in a groove in the piece DE, ſo as always to preſerve its paralleliſm to the external pieces DC, which are fixed at a diſtance equal to the length of the ruler, and have their edges placed in ſuch a manner as to form with the parallel lines which they interſect a ratio, which by compoſition is $\frac{1}{10}$; which in the preſent caſe requires them to be at right angles to the length. The piece DE is applied to the edge FG of the ruler. The edges or borders H, I, K, L, are more conveniently made of tranſparent horn, or tortoiſe-ſhell, than of any opaque matter.

In uſing this ruler, apply the edge of either B or C to the conſequent, and ſlide the piece A to the antecedent; obſerving the difference between the numbers on the pieces denoting the lines they are found on: then, applying the ſame edge of A to any other antecedent, the other piece B or C will interſect a conſequent in the ſame ratio upon that line, having the ſame ſituation with regard to the antecedent that the line of the former conſequent had to its antecedent. But if B be the conſequent piece, and fall without the ruler, the piece C will ſhow the conſequent one line lower; or if C, in like manner, fall without the ruler, then B will ſhow the conſequent one line higher.—"It might be convenient (ſays Mr Nicholſon) for the purpoſe of computation, to make inſtruments of this kind with one hundred or more lines: but in the preſent inſtrument, the numbers on the pieces will anſwer the ſame purpoſe; for if a conſequent fall upon a line at any given number of intervals without the ruler, it will be found on that line of the arrangement which occupies the ſame number of intervals reckoned inwards from the oppoſite edge of the ruler."

Fig. 9. is an inſtrument on the plan of a Gunter's ſcale of $28\frac{1}{2}$ inches long, invented by Mr Robertſon. There is a moveable piece AB in the ſlider GH, acroſs which is drawn a fine line; the ſlider having alſo lines CD, EF, drawn acroſs it at diſtances from each other equal to the length of the ruler AB. In uſing the inſtrument, the line CD or EF is to be placed at the conſequent, and the line in AB at the antecedent: then, if the piece AB be placed at any other antecedent, the ſame line CD or EF will indicate its conſequent in the ſame ratio taken the ſame way: that is, if the antecedent and conſequent lie on the ſame ſide of the ſlider, all other antecedents and conſequents in that ratio will be in the ſame manner; and the contrary if they do not. But if the conſequent line fall without the rule, the other fixed line on the ſlider will ſhow the conſequent, but on the contrary ſide of the ſlider to that where it would elſe have been ſeen by means of the firſt conſequent line.

Fig. 10. is a circular inſtrument equivalent to the former; conſiſting of three concentric circles engraved and graduated upon a plate of an inch and a half diameter. Two legs A and B proceed from the centre, having right-lined edges in the direction of radii; and are moveable either ſingly or together. In uſing the inſtrument, place one of the edges at the antecedent and the other at the conſequent, and fix them at the angle. Move the two legs then together; and having placed the antecedent leg at any other number, the other will give the conſequent one in the like poſition on the lines. If the line CD happen to lie between the legs, and B be the conſequent leg, the number ſought will be found one line farther from the centre than it would otherwiſe have been; and on the contrary, it will be found one line nearer in the like caſe, if A be the conſequent leg. "This inſtrument (ſays Mr Nicholſon), differing from that repreſented fig. 7. only in its circular form, and the advantages reſulting from that form, the lines muſt be taken to ſucceed each other in the ſame manner laterally; ſo that numbers which fall either within or without the arrangement of circles, will be found on ſuch lines of the arrangement as would have occupied the vacant places if the ſucceſſion of lines had been indefinitely repeated ſidewiſe.

"I approve of this conſtruction as ſuperior to every other which has yet occurred to me, not only in point of convenience, but likewiſe in the probability of being better executed; becauſe ſmall arcs may be graduated with very great accuracy, by diviſions transferred from a larger original. The inſtrument, fig. 7. may be contained conveniently in a circle of about four inches and a half diameter.

"The circular inſtrument is a combination of the Gunter's line and the ſector, with the improvements here pointed out. The property of the ſector may be uſeful in magnifying the differences of the logarithms in the upper parts of the line of ſines, the middle of the tangents, and the beginning of the verſed ſines. It is even poſſible, as mathematicians will eaſily conceive, to draw ſpirals, on which graduations of parts, everywhere equal to each other, will ſhow the ratios of thoſe lines by moveable radii, ſimilar to thoſe in this inſtrument."

LOGIC.

LOGIC is the art of thinking and reaſoning juſtly; or, it may be defined the ſcience or hiſtory of the human mind, inaſmuch as it traces the progreſs of our knowledge from our firſt and moſt ſimple conceptions through all their different combinations, and all thoſe numerous deductions that reſult from variouſly comparing them one with another.

The preciſe buſineſs of logic therefore is, To explain the nature of the human mind, and the proper manner of conducting its ſeveral powers, in order to the attain-

ment

Of Perception.

ment of truth and knowledge. It lays open thofe errors and miftakes we are apt, through inattention, to run into; and teaches us how to diftinguifh between truth, and what only carries the appearance of it. By thefe means we grow acquainted with the nature and force of the underftanding; fee what things lie within its reach; where we may attain certainty and demonftration; and when we muft be contented with probability.

This fcience is generally divided into four parts, viz. *Perception*, *Judgement*, *Reafoning*, and *Method*. This divifion comprehends the whole hiftory of the fenfations and operations of the human mind.

PART I. OF PERCEPTION.

WE find ourfelves furrounded with a variety of objects, which acting differently upon our fenfes, convey diftinct impreffions into the mind, and thereby roufe the attention and notice of the underftanding. By reflecting too on what paffes within us, we become fenfible of the operations of our own minds, and attend to them as a new fet of impreffions. But in all this there is only bare *confcioufnefs*. The mind, without proceeding any farther, takes notice of the impreffions that are made upon it, and views things in order, as they prefent themfelves one after another. This attention of the underftanding to the object acting upon it, whereby it becomes fenfible of the impreffions they make, is called by logicians *perception;* and the notices themfelves, as they exift in the mind, and are there treafured up to be the materials of thinking and knowledge, are diftinguifhed by the name of *ideas*. In the article METAPHYSICS it fhall be fhown at large, how the mind, being furnifhed with ideas, contrives to diverfify and enlarge its ftock: we have here chiefly to confider the means of making known our thoughts to others; that we may not only underftand how knowledge is acquired, but alfo in what manner it may be communicated with the greateft certainty and advantage.

CHAP. I. *Of Words, confidered as the figns of our Ideas.*

1 Words furnifh the means of recording our own thoughts;

I. OUR ideas, though manifold and various, are neverthelefs all within our own breafts, invifible to others, nor can of themfelves be made appear. But God, defigning us for fociety, and to have fellowfhip with thofe of our kind, has provided us with organs fitted to frame articulate founds, and given us alfo a capacity of ufing thofe founds as figns of internal conceptions. Hence fpring words and language: for, having once pitched upon any found to ftand as the mark of an idea in the mind, cuftom by degrees eftablifhes fuch a connexion between them, that the appearance of the idea in the underftanding always brings to our remembrance the found or name by which it is expreffed; as in like manner the hearing of the found never fails to excite the idea for which it is made to ftand. And thus it is eafy to conceive how a man may record his own thoughts, and bring them again into view in any fucceeding period of life. For this connexion being once fettled, as the fame founds will always ferve to excite the fame ideas; if he can but contrive to regifter his words in the order and difpofition in which the prefent train of his thoughts prefent themfelves to his imagination, it is evident he will be able to recal thefe thoughts at pleafure, and that too in the very manner of their firft appearance. Accordingly we find, that the inventions of writing and printing, by enabling us to fix and perpetuate fuch perifhable things as founds, have alfo furnifhed us with the means of giving a kind of permanency to the tranfactions of the mind, infomuch that they may be in the fame manner fubjected to our review as any other objects of nature.

2 and of the mutual communication of knowledge from one man to another.

II. But befides the ability of recording our own thoughts, there is this farther advantage in the ufe of external figns, that they enable us to communicate our thoughts to *others*, and alfo to receive information of what paffes in *their* breafts. For any number of men, having agreed to eftablifh the fame founds as figns of the fame ideas, it is apparent that the repetition of thefe founds muft excite the like perceptions in each, and create a perfect correfpondence of thoughts. When, for inftance, any train of ideas fucceed one another in my mind, if the names by which I am wont to exprefs them have been annexed by thofe with whom I converfe to the very fame fet of ideas, nothing is more evident, than that, by repeating thofe names according to the tenor of my prefent conceptions, I fhall raife in their minds the fame courfe of thought as has taken poffeffion of my own. For by barely attending to what paffes within themfelves upon hearing the founds which I repeat, they will alfo become acquainted with the ideas in my underftanding, and have them in a manner laid before their view. So that we here clearly perceive how a man may communicate his fentiments, knowledge, and difcoveries to others, if the language in which he converfes be extenfive enough to mark all the ideas and tranfactions of his mind. But as this is not always the cafe, and men are often obliged to invent terms of their own to exprefs new views and conceptions of things; it may be afked, how in thefe circumftances we can become acquainted with the thoughts of another, when he makes ufe of words, to which we have never annexed any ideas, and that of courfe can raife no perceptions in our minds? In order to unveil this myftery, and give fome little infight into the foundation, growth, and improvement of language, the following obfervations will be found of confiderable moment.

3 Simple ideas cannot be conveyed into the mind by words, or a defcription.

III. Firft, That no word can be to any man the fign of an idea, till that idea comes to have a real exiftence in his mind. For names, being only fo far intelligible as they denote known internal conceptions; where they have none fuch to anfwer them, there they are plainly founds without fignification, and of courfe convey no inftruction or knowledge. But no fooner are the ideas to which they belong raifed in the underftanding, than, finding it eafy to connect them with the eftablifhed names, we can join in any agreement of this kind made by others, and thereby enjoy the

Of Perception.

benefit of their discoveries. The first thing therefore to be considered is, how these ideas may be conveyed into the mind; that being there, we may learn to connect them with their appropriated sounds, and so become capable of understanding others when they make use of these sounds in laying open and communicating their thoughts. Now, to comprehend this distinctly, it will be necessary to attend to the division of our ideas into simple and complex, (see METAPHYSICS.) And first, as for our simple ideas; they can find no admission into the mind, but by the two original fountains of knowledge, sensation and reflection. If therefore any of these have as yet no being in the understanding, it is impossible by words or a description to excite them there. A man who had never felt the sensation of *heat*, could not be brought to comprehend that sensation by any thing we might say to explain it. If we would really produce the idea in him, it must be by applying the proper object to his senses, and bringing him within the influence of a hot body. When this is done, and experience has taught him the perception to which men have annexed the name *heat*, it then becomes to him the sign of that idea, and he thenceforth understands the meaning of the term, which, before, all the words in this world would not have been sufficient to convey into his mind. The case is the same in respect of light and colours. A man born blind, and thereby deprived of the only conveyance for the ideas of this class, can never be brought to understand the names by which they are expressed. The reason is plain: they stand for ideas that have no existence in his mind; and as the organ appropriated to their reception is wanting, all other contrivances are vain, nor can they by any force or description be raised in his imagination. But it is quite otherwise in our complex notions. For these being no more than certain combinations of simple ideas, put together in various forms; if the original ideas out of which the collections are made have already got admission into the understanding, and the names serving to express them are known; it will be easy, by enumerating the several ideas concerned in the composition, and marking the order and manner in which they are united, to raise any complex conception in the mind. Thus the idea answering to the word *rainbow* may be readily excited in the imagination of another who has never seen the appearance itself, by barely describing the figure, largeness, position, and order of colours; if we suppose these several simple ideas, with their names, sufficiently known to him.

4
The names of complex ideas definable; those of simple ideas not.

IV. And this leads to a second observation upon this subject, namely, That words standing for complex ideas are all definable, but those by which we denote simple ideas are not; for simple ideas being secondary perceptions, which have no other entrance into the mind than by sensation or reflection, can only be got by experience, from the several objects of nature, proper to produce those perceptions in us. Words indeed may very well serve to remind us of them, if they have already found admission into the understanding, and their connexion with the established names is known; but they can never give them their original being and existence there. And hence it is, that when any one asks the meaning of a word denoting a simple idea, we pretend not to explain it to him by a definition, well knowing that to be impossible; but, supposing him already acquainted with the idea, and only ignorant of the name by which it is called, we either mention it to him by some other name with which we presume he knows its connexion, or appeal to the object where the idea itself is found. Thus, were any one to ask the meaning of the word *white*, we should tell him it stood for the same idea as *albus* in Latin, or *blanc* in French; or, if we thought him a stranger to these languages, we might appeal to an object producing the idea, by saying it denoted the colour we observe in *snow* or *milk*. But this is by no means a definition of the word, exciting a new idea in his understanding; but merely a contrivance to remind him of a known idea, and teach him its connexion with the established name. For if the ideas after which he inquires have never yet been raised in his mind; as suppose one who had seen no other colours than *black* and *white*, should ask the meaning of the word *scarlet*; it is easy to perceive, that it would be no more possible to make him comprehend it by words, or a definition, than to introduce the same perception into the imagination of a man born blind. The only method in this case is, to present some object, by looking at which the perception itself may be excited; and thus he will learn both the name and the idea together.

5
Experience and observation bring men to an agreement in the names of simple ideas.

V. But how comes it to pass that men agree in the names of their simple ideas, seeing they cannot view the perceptions in one another's minds, nor make known these perceptions by words to others? The effect is produced by experience and observation. Thus finding, for instance, that the name of *heat* is annexed to that sensation which men feel when they approach the fire, I make it also the sign of the sensation excited in me by such an approach, nor have any doubt but it denotes the same perception in my mind as in theirs. For we are naturally led to imagine, that the same objects operate alike upon the organs of the human body, and produce an uniformity of sensations. No man fancies, that the idea raised in him by the taste of *sugar*, and which he calls *sweetness*, differs from that excited in another by the like means; or that *wormwood*, to whose relish he has given the epithet *bitter*, produces in another the sensation which he denotes by the word *sweet*. Presuming therefore upon this conformity of perceptions, when they arise from the same objects, we easily agree as to the names of our simple ideas: and if at any time, by a more narrow scrutiny into things, new ideas of this class come in our way, which we choose to express by terms of our own invention; these names are explained, not by a definition, but by referring to the objects whence the ideas themselves may be obtained.

6
The conveyance of complex ideas by definitions, a wise contrivance in nature;

VI. Being in this manner furnished with simple ideas, and the names by which they are expressed; the meaning of terms that stand for complex ideas is easily got, because the ideas themselves answering to these terms may be conveyed into the mind by definitions. For our complex notions are only certain combinations of simple ideas. When therefore these are enumerated, and the manner in which they are united into one conception explained, nothing more is wanting to raise that conception in the understanding; and thus the term denoting it comes of course to be understood. And here it is worth while to reflect

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Of Perception.

a little upon the wiſe contrivance of nature, in thus furniſhing us with the very apteſt means of communicating our thoughts. For were it not ſo ordered, that we could thus convey our complex ideas from one to another by definitions, it would in many caſes be impoſſible to make them known at all. This is apparent in thoſe ideas which are the proper work of the mind. For as they exiſt only in the underſtanding, and have no real objects in nature in conformity to which they are framed; if we could not make them known by deſcription, they muſt lie for ever hid within our own breaſts, and be confined to the narrow acquaintance of a ſingle mind. All the fine ſcenes that ariſe from time to time in the poet's fancy, and by his lively painting give ſuch entertainment to his readers, were he deſtitute of this faculty of laying them open to the view of others by words and deſcription, could not extend their influence beyond his own imagination, or give joy to any but the original inventor.

7 and of great avail towards the improvement of knowledge.

VII. There is this farther advantage in the ability we enjoy of communicating our complex notions by definitions; that as theſe make by far the largeſt claſs of our ideas, and moſt frequently occur in the progreſs and improvement of knowledge, ſo they are by theſe means imparted with the greateſt readineſs, than which nothing would tend more to the increaſe and ſpreading of ſcience: for a definition is ſoon peruſed; and if the terms of it are well underſtood, the idea itſelf finds an eaſy admiſſion into the mind. Whereas, in ſimple perceptions, where we are referred to the objects producing them, if theſe cannot be come at, as is ſometimes the caſe, the names by which they are expreſſed muſt remain empty ſounds. But new ideas of this claſs occurring very rarely in the ſciences, they ſeldom create any great obſtruction. It is otherwiſe with our complex notions; for every ſtep we take leading us into new combinations and views of things, it becomes neceſſary to explain theſe to others, before they can be made acquainted with our diſcoveries: and as the manner of definitions is eaſy, requiring no apparatus but that of words, which are always ready, and at hand; hence we can with the leſs difficulty remove ſuch obſtacles as might ariſe from terms of our own invention, when they are made to ſtand for new complex ideas ſuggeſted to the mind by ſome preſent train of thinking. And thus at laſt we are let into the myſtery hinted at in the beginning of this chapter, viz. how we may become acquainted with the thoughts of another, when he makes uſe of words to which we have as yet joined no ideas. The anſwer is obvious from what has been already ſaid. If the terms denote ſimple perceptions, he muſt refer us to theſe objects of nature whence the perceptions themſelves are to be obtained; but, if they ſtand for complex ideas, their meaning may be explained by a *definition*.

Chap. II. *Of Definition.*

8 Definition defined.

I. A Definition *is the unfolding of ſome conception of the mind, anſwering to the word or term made uſe of as the ſign of it.* Now as, in exhibiting any idea to another, it is neceſſary that the deſcription be ſuch as may excite that preciſe idea in his mind; hence it is plain that definitions, properly ſpeaking, are not arbitrary, but confined to the repreſenting of certain determinate ſettled notions, ſuch namely as are annexed by the ſpeaker or writer to the words he uſes. As nevertheleſs it is univerſally allowed that the ſignification of words is perfectly voluntary, and not the effect of any natural and neceſſary connexion between them and the ideas for which they ſtand; ſome may perhaps wonder why definitions are not ſo too. In order therefore to unravel this difficulty, and ſhow diſtinctly what is and what is not arbitrary in ſpeech, we muſt carefully diſtinguiſh between the connexion of our words and ideas, and the unfolding of the ideas themſelves.

9 The connexion between words and ideas, a perfectly voluntary eſtabliſhment.

II. Firſt, as to the connexion of our words and ideas; this, it is plain, is a purely arbitrary inſtitution. When, for inſtance, we have in our minds the idea of any particular ſpecies of metals, the calling it by the name *gold* is an effect of the voluntary choice of men ſpeaking the ſame language, and not of any peculiar aptneſs in that ſound to expreſs that idea. Other nations we find make uſe of different ſounds, and with the ſame effect. Thus *aurum* denotes that idea in Latin, and *or* in French; and even the word *gold* itſelf would have as well ſerved to expreſs the idea of that metal which we call *ſilver*, had cuſtom in the beginning eſtabliſhed it.

10 The deſcription of ideas not ſo, but bounded to the repreſentation of that preciſe appearance by which they are diſtinguiſhed among themſelves.

III. But although we are thus entirely at liberty in connecting any idea with any ſound, yet it is quite otherwiſe in unfolding the ideas themſelves. For every idea having a preciſe appearance of its own, by which it is diſtinguiſhed from every other idea: it is manifeſt, that in laying it open to others, we muſt ſtudy ſuch a deſcription as ſhall exhibit that peculiar appearance. When we have formed to ourſelves the idea of a figure bounded by four equal ſides, joined together at right angles, we are at liberty to expreſs that idea by any ſound, and call it either a *ſquare* or a *triangle*. But whichever of theſe names we uſe, ſo long as the idea is the ſame, the deſcription by which we would ſignify it to another muſt be ſo too. Let it be called *ſquare* or *triangle*, it is ſtill a figure having four equal ſides, and all its angles right ones. Hence we clearly ſee what is and what is not arbitrary in the uſe of words. The eſtabliſhing any ſound as the mark of ſome determinate idea in the mind, is the effect of free choice, and a voluntary combination among men: and as different nations make uſe of different ſounds to denote the ſame ideas, hence proceeds all that variety of languages which we meet with in the world. But when a connexion between our ideas and words is once ſettled, the unfolding of the idea anſwering to any word, which properly conſtitutes a definition, is by no means an arbitrary thing: for here we are bound to exhibit that preciſe conception which either the uſe of language, or our own particular choice, hath annexed to the term we uſe.

11 Cauſes of the obſcurity that has hitherto perplexed the theory of definitions.

IV. And thus it appears, that definitions, conſidered as deſcriptions of ideas in the mind, are ſteady and invariable, being bounded to the repreſentation of theſe preciſe ideas. But then, in the application of definitions to particular names, we are altogether left to our own free choice. Becauſe as the connecting of any idea with any ſound is a perfectly arbitrary inſtitution, the applying the deſcription of that idea to that ſound muſt be ſo too. When therefore logicians tell

us

Of Perception.

us that the definition of the name is arbitrary, they mean no more than this; that as different ideas may be connected with any term, according to the good pleaſure of him that uſes it; in like manner may different deſcriptions be applied to the term, ſuitable to the ideas ſo connected. But this connexion being ſettled, and the term conſidered as the ſign of ſome fixed idea in the underſtanding, we are no longer left to arbitrary explications, but muſt ſtudy ſuch a deſcription as correſponds with that preciſe idea. Now this alone, according to what has been before laid down, ought to be accounted a definition. What ſeems to have occaſioned no ſmall confuſion in this matter, is, that many explanations of words, where no idea is unfolded, but merely the connexion between ſome word and idea aſſerted, have yet been dignified with the name of definitions. Thus, when we ſay that *a clock is an inſtrument by which we meaſure time;* that is by ſome called a definition; and yet it is plain that we are beforehand ſuppoſed to have an idea of this inſtrument, and only taught that the word *clock* ſerves in common language to denote that idea. By this rule all explications of words in our dictionaries will be definitions, nay, the names of even ſimple ideas may be thus defined. *White*, we may ſay, is the colour we obſerve in ſnow or milk; *heat* the ſenſation produced by approaching the fire; and ſo in innumerable other inſtances. But theſe, and all others of the like kind, are by no means definitions, exciting new ideas in the underſtanding, but merely contrivances to remind us of known ideas, and teach their connexion with the eſtabliſhed names.

12 Complex ideas alone capable of that kind of deſcription which goes by the name of a definition.

V. But now in definitions properly ſo called, we firſt conſider the term we uſe, as the ſign of ſome inward conception, either annexed to it by cuſtom, or our own free choice: and then the buſineſs of the definition is to unfold and explicate that idea. As therefore the whole art lies in giving juſt and true copies of our ideas; a definition is then ſaid to be made perfect, when it ſerves diſtinctly to excite the idea deſcribed in the mind of another, even ſuppoſing him before wholly unacquainted with it. This point ſettled, let us next inquire what thoſe ideas are which are capable of being thus unfolded? and in the firſt place it is evident, that all our ſimple ideas are neceſſarily excluded. We have ſeen already that experience alone is to be conſulted here, inſomuch that if either the objects whence they are derived come not in our way, or the avenues appointed by nature for their reception are wanting, no deſcription is ſufficient to convey them into the mind. But where the underſtanding is already ſupplied with theſe original and primitive conceptions, as they may be united together in an infinity of different forms; ſo may all their ſeveral combinations be diſtinctly laid open, by enumerating the ſimple ideas concerned in the various collections, and tracing the order and manner in which they are linked one to another. Now theſe combinations of ſimple notices conſtitute what we call our complex notions, whence it is evident, that complex ideas, and thoſe alone, admit of that kind of deſcription which goes by the name of a definition.

VI. Definitions, then, are pictures or repreſentations of our ideas; and as theſe repreſentations are then only poſſible when the ideas themſelves are complex, it is obvious to remark, that definitions cannot have place, but where we make uſe of terms ſtanding for ſuch complex ideas. But our complex ideas being, as we have ſaid, nothing more than different combinations of ſimple ideas; we then know and comprehend them perfectly, when we know the ſeveral ſimple ideas of which they conſiſt, and can ſo put them together in our minds as may be neceſſary towards the framing of that peculiar connexion which gives every idea its diſtinct and proper appearance.

13 Two things required in a definition, to enumerate the ideas and explain the manner of their combinations.

VII. Two things are therefore required in every definition: firſt, That all the original ideas, out of which the complex one is formed, be diſtinctly enumerated; and, ſecondly, That the order and manner of combining them into one conception be clearly explained. Where a definition has theſe requiſites, nothing is wanting to its perfection; becauſe every one who reads it and underſtands the terms, ſeeing at once what ideas he is to join together, and alſo in what manner, can at pleaſure form in his own mind the complex conception anſwering to the term defined. Let us, for inſtance, ſuppoſe the word *ſquare* to ſtand for that idea by which we repreſent to ourſelves a figure whoſe ſides ſubtend quadrants of a circumſcribed circle. The parts of this idea are the ſides bounding the figure. Theſe muſt be four in number, and all equal among themſelves, becauſe they are each to ſubtend a fourth part of the ſame circle. But, beſides theſe component parts, we muſt alſo take notice of the manner of putting them together, if we would exhibit the preciſe idea for which the word *ſquare* here ſtands. For four equal right lines, anyhow joined, will not ſubtend quadrants of a circumſcribed circle. A figure with this property muſt have its ſides ſtanding alſo at right angles. Taking in therefore this laſt conſideration reſpecting the manner of combining the parts, the idea is fully deſcribed, and the definition thereby rendered complete. For a figure bounded by four equal ſides, joined together at right angles, has the property required; and is moreover the only right-lined figure to which that property belongs.

14 How we are to proceed to arrive at juſt and adequate definitions.

VIII. It will now be obvious to every one, in what manner we ought to proceed, in order to arrive at juſt and adequate definitions. Firſt, We are to take an exact view of the idea to be deſcribed, trace it to its original principles, and mark the ſeveral ſimple perceptions that enter into the compoſition of it. Secondly, We are to conſider the particular manner in which theſe elementary ideas are combined, in order to the forming of that preciſe conception for which the term we make uſe of ſtands. When this is done, and the idea wholly unravelled, we have nothing more to do than fairly tranſcribe the appearance it makes to our own minds. Such a deſcription, by diſtinctly exhibiting the order and number of our primitive conceptions, cannot fail to excite at the ſame time in the mind of every one that reads it, the complex idea reſulting from them; and therefore attains the true and proper end of a definition.

Chap. III. *Of the Compoſition and Reſolutions of our our Ideas, and the Rules of Definition thence ariſing.*

I. The rule laid down in the foregoing chapter is general, extending to all poſſible caſes; and is indeed that

Of Perception.

that to which alone we can have recourſe, where any doubt or difficulty ariſes. It is not, however, neceſſary that we ſhould practiſe it in every particular inſtance.

15 In compounding our ideas, we proceed by a ſucceſſive gradation.

Many of our ideas are extremely complicated, inſomuch that to enumerate all the ſimple perceptions out of which they are formed, would be a very troubleſome and tedious work. For this reaſon logicians have eſtabliſhed certain compendious rules of defining, of which it may not be amiſs here to give ſome account. But in order to the better underſtanding of what follows, it will be neceſſary to obſerve, that there is a certain gradation in the compoſition of our ideas. The mind of man is very limited in its views, and cannot take in a great number of objects at once. We are therefore fain to proceed by ſteps, and make our firſt advances ſubſervient to thoſe which follow. Thus, in forming our complex notions, we begin at firſt with but a few ſimple ideas, ſuch as we can manage with eaſe, and unite them together into one conception. When we are provided with a ſufficient ſtock of theſe, and have by habit and uſe rendered them familiar to our minds, they become the component parts of other ideas ſtill more complicated, and form what we may call a ſecond order of compound notions. This proceſs, as is evident, may be continued to any degree of compoſition we pleaſe, mounting from one ſtage to another, and enlarging the number of combinations.

16 Hence ideas of this claſs beſt comprehended, when we advance gradually through all the ſeveral orders.

II. But now in a ſeries of this kind, whoever would acquaint himſelf perfectly with the laſt and higheſt order of ideas, finds it much the moſt expedient method to proceed gradually through all the intermediate ſteps. For, were he to take any very compound idea to pieces, and, without regard to the ſeveral claſſes of ſimple perceptions that have already been formed into diſtinct combinations, break it at once into its original principles, the number would be ſo great as perfectly to confound the imagination, and overcome the utmoſt reach and capacity of the mind. When we ſee a prodigious multitude of men jumbled together in crowds, without order or any regular poſition, we find it impoſſible to arrive at an exact knowledge of their number. But if they are formed into ſeparate battalions, and ſo ſtationed as to fall within the leiſure ſurvey of the eye; by viewing them ſucceſſively and in order, we come to an eaſy and certain determination. It is the ſame in our complex ideas. When the original perceptions, out of which they are framed, are very numerous, it is not enough that we take a view of them in looſe and ſcattered bodies; we muſt form them into diſtinct claſſes, and unite theſe claſſes in a juſt and orderly manner, before we can arrive at a true knowledge of the compound notices reſulting from them.

17 Our definitions ſhould keep pace with our ideas, and obſerve a like gradation.

III. This gradual progreſs of the mind to its compound notions, through a variety of intermediate ſteps, plainly points out the manner of conducting the definitions by which theſe notions are conveyed into the minds of others. For as the ſeries begins with ſimple and eaſy combinations, and advances through a ſucceſſion of different orders, riſing one above another in the degree of compoſition, it is evident, that, in a train of definitions expreſſing theſe ideas, a like gradation is to be obſerved. Thus the complex ideas of the loweſt order can no otherwiſe be deſcribed than by enumerating the ſimple ideas out of which they are made, and explaining the manner of their union. But then in the ſecond, or any other ſucceeding order, as they are formed out of thoſe gradual combinations, and conſtitute the inferior claſſes, it is not neceſſary, in deſcribing them, to mention one by one all the ſimple ideas of which they conſiſt. They may be more diſtinctly and briefly unfolded, by enumerating the compound ideas of a lower order, from whoſe union they reſult, and which are all ſuppoſed to be already known in conſequence of previous definitions. Here then it is that the logical method of defining takes place; which, that it may be the better underſtood, we ſhall explain ſomewhat more particularly the ſeveral ſteps and gradations of the mind in compounding its ideas, and thence deduce that peculiar form of a definition which logicians have thought fit to eſtabliſh.

18 The ſteps by which the mind proceeds from particular to general ideas.

IV. All the ideas we receive from the ſeveral objects of nature that ſurround us, repreſent diſtinct individuals. Theſe individuals, when compared together, are found in certain particulars to reſemble each other. Hence, by collecting the reſembling particulars into one conception, we form the notion of a *ſpecies*. And here let it be obſerved, that this laſt idea is leſs complicated than that by which we repreſent any of the particular objects contained under it. For the idea of the ſpecies excludes the peculiarities of the ſeveral individuals, and retains only ſuch properties as are common to them all. Again, By comparing ſeveral ſpecies together, and obſerving their reſemblance, we form the idea of a *genus*; where, in the ſame manner as before, the compoſition is leſſened, becauſe we leave out what is peculiar to the ſeveral ſpecies compared, and retain only the particulars wherein they agree. It is eaſy to conceive the mind proceeding thus from one ſtep to another, and advancing through its ſeveral claſſes of general notions, until at laſt it comes to the higheſt genus of all, denoted by the word *being*, where the bare idea of exiſtence is only concerned.

19 The conduct of the mind in compounding its ideas, as it advances through the different orders of perception.

V. In this procedure we ſee the mind unravelling a complex idea, and tracing it in the aſcending ſcale, from greater or leſs degrees of compoſition, until it terminates in one ſimple perception. If now we take the ſeries the contrary way, and, beginning with the laſt or higheſt genus, carry our view downwards, through all the inferior genera and ſpecies, quite to the individuals, we ſhall thereby arrive at a diſtinct apprehenſion of the conduct of the underſtanding in compounding its ideas. For, in the ſeveral claſſes of our perceptions, the higheſt in the ſcale is for the moſt part made up of but a few ſimple ideas, ſuch as the mind can take in and ſurvey with eaſe. This firſt general notion, when branched out into the different ſubdiviſions contained under it, has in every one of them ſomething peculiar, by which they are diſtinguiſhed among themſelves; inſomuch that, in deſcending from the genus to the ſpecies, we always ſuperadd ſome new idea, and thereby increaſe the degree of compoſition. Thus the idea denoted by the word *figure* is of a very general nature, and compoſed of but few ſimple perceptions, as implying no more than ſpace everywhere bounded. But if we deſcend farther, and conſider the boundaries of this ſpace, as that they may be either lines or ſurface, we fall

Of Perception.

fall into the several species of figure. For where the space is bounded by one or more surfaces, we give it the name of a *solid figure;* but where the boundaries are lines, it is called a *plain figure* (A).

20 The idea of the species found by superadding the specific difference to the genus.

VI. In this view of things it is evident, that the species is formed by superadding a new idea to the genus. Here, for instance, the genus is circumscribed space. If now to this we superadd the idea of a circumscription by lines, we frame the notion of that species of figures which are called *plain;* but if we conceive the circumscription to be by surfaces, we have the species of solid figures. This superadded idea is called the *specific difference*, not only as it serves to divide the species from the genus, but because, being different in all the several subdivisions, we thereby also distinguish the species one from another. And as it is likewise that conception, which, by being joined to the general idea, completes the notion of the species: hence it is plain, that the genus and specific difference are to be considered as the proper and constituent parts of the species. If we trace the progress of the mind still farther, and observe it advancing through

(A) This account of the composition and resolution of our ideas is agreeable to the common doctrine of logicians on the subject. Into the truth of the doctrine itself we shall inquire afterwards under the article METAPHYSICS: but to prevent mistakes, it may be proper to observe here, that though every writer of logic has treated largely of *general* and *specific ideas*, there is in reality nothing *general* in the matter but the *terms of language*. When we utter, for instance, the word *triangle*, that *general term* does not, as has been often said, suggest to the mind the *general idea* of a triangle, which is neither *oblique* nor *rectangle*, neither *equilateral* nor *scalenon*, &c. for *such* a triangle, as it cannot *exist* in *nature*, cannot be *conceived* in *idea*. In like manner, the *general term Virtue* does not excite a general *idea* of *virtue*, which is neither *prudence*, nor *temperance*, nor *fortitude*, nor *justice*, nor *charity*, &c. for that which is *distinct* from *all these* is not *virtue*. What then is the import of such *general terms?* The answer is obvious: they denote *classes of objects;* and are never used without some word of limitation, but when something that has no dependence upon the *particular qualities*, which distinguish the individuals from each other, is affirmed or denied of the whole class. Thus we may affirm, that the *three angles of a plain triangle are equal to two right angles:* and this proposition is demonstrably true, *not* of a triangle, which is neither *oblique* nor *rectangle*, neither *equilateral* nor *scalenon*, for such a triangle never was conceived; but of *all these* triangles equally, as the truth of the proposition and the progress of the demonstration has no dependence upon the *peculiarities* which *distinguish* these triangles from one another. Again, When we say that *a man of virtue will be rewarded by God*, we do not mean by the word *virtue* a *general idea* making part of each of the complex and more *particular* ideas of *prudence*, *fortitude*, *justice*, &c. and at the same time *different* from them all; but we affirm, that the man who practises *any* or *all* of these virtues, according as he has opportunity, will be rewarded by God.

The history of our ideas is shortly this:—That act of the mind, if it may be called an *act*, which makes known an *external object*, is termed PERCEPTION. That act of the mind which makes known an *internal object*, is termed CONSCIOUSNESS. Objects once perceived may be recalled to the mind by the power of *memory;* and when they are so recalled, we have a perception of them in all respects similar to the original perception, only less distinct; we fancy *ourselves* in the *same place*, and the *object perceived* attended by the *same circumstances*. This indistinct *secondary perception* of an object is termed an IDEA; and therefore the precise and accurate definition of an *idea*, in contradistinction to an *original perception*, is "that perception of a real object which is raised in the mind by the power of memory." Now all our *original perceptions* being of *particular objects*, it is obvious that our *ideas*, which are only those perceptions recalled, must be of *particular objects likewise*, and that no man can have an *idea* of a thing of which the *real existence* is contradictory and impossible. But the *general* and *specific ideas* of logicians, are ideas of *nothing which exists*, or *which can possibly exist*. They are acquired, we are told, by *abstraction*, in the following manner. Among a number of individuals we perceive certain qualities the same in all, whilst in each individual there are other qualities which have nothing similar to them in any other individual: now the mind, it is said, has a power of abstracting the *particular qualities* of *each individual* from *those* which are *common to the whole*, and of these last forming a *general idea* of the whole class. Thus all men have nearly the *same form;* and they have each *some stature* and *some colour*, though there are not perhaps two individuals who have *precisely the same stature* and the *same colour*. Now, say the advocates for general ideas, if we *abstract* what is *peculiar* to *each individual*, and retain what is *common* to the *whole race*, we have the *general idea* signified by the word *man*. That is, if we conceive a being in human shape, which is of *stature* and *colour*, but neither *tall* nor *short*, neither *white* nor *black*, nor *red* nor *brown*, nor *any other colour which we ever saw*, we have the *general idea* of *humanity*, and understand the meaning of the *word man!* Surely no person who is not the slave of prejudice will pretend that he can frame such an idea as this—the idea of an object which cannot possibly exist in nature.

By this we do not mean to affirm, that we cannot frame ideas of such objects as have *no real* existence; for it is as easy to imagine a man with *ten heads* as *with one*, because there is nothing contradictory between *ten heads* and *one body*. But *figure*, which is said to be space bounded *neither by lines nor superficies; colour*, which is neither *red* nor *white*, nor *blue* nor *black*, &c.; and *animal*, which is neither *man*, *beast*, *bird*, nor *insect;* are impossible in nature, and inconceivable in idea. There is, however, no harm in still retaining the phrase *general idea*, provided he who uses it takes care to let it be known, that by these words he means not *any abstract* and *contradictory idea*, but merely a *class* of *real objects*. The phrase may at times prevent much circumlocution; for which reason we have retained the use of it in the text.

3

through the inferior ſpecies, we ſhall find its manner of proceeding to be always the ſame. For every lower ſpecies is formed by ſuperadding ſome new idea to the ſpecies next above it; inſomuch that in this deſcending ſcale of our perceptions, the underſtanding paſſes through different orders of complex notions, which become more and more complicated at every ſtep it takes. Let us reſume here, for inſtance, the ſpecies of plain figures. They imply no more than ſpace bounded by lines. But if we take in an additional conſideration of the nature of theſe lines, as whether they are *right* or *curves*, we fall into the ſubdiviſions of plain figure, diſtinguiſhed by the names of *rectilinear*, *curvilinear*, and *mixtilinear*.

21
And in all the inferior ſpecies by ſuperadding the ſpecific difference to the neareſt genus.

VII. And here we are to obſerve, that though plain figures, when conſidered as one of thoſe branches that come under the notions of figure in general, take the name of a ſpecies; yet compared with the claſſes of curvilinear, rectilinear, and mixtilinear, into which they themſelves may be divided, they really become a genus, of which the beforementioned ſubdiviſions conſtitute the ſeveral ſpecies. Theſe ſpecies, in the ſame manner as in the caſe of plane and ſolid figures, conſiſt of the genus and ſpecific difference as their conſtituent parts. For in the curvilinear kind, the curvity of the lines bounding the figure makes what is called the *ſpecific difference;* to which if we join the genus, which here is a plain figure or ſpace circumſcribed by lines, we have all that is neceſſary towards completing the notion of this ſpecies. We are only to take notice, that this laſt ſubdiviſion, having two genera above it, viz. plain figure, and figure in general; the genus joined with the ſpecific difference, in order to conſtitute the ſpecies of curvilinears, is that which lies neareſt to the ſaid ſpecies. It is the notion of plain figure, and not of figure in general, that joined with the idea of curvity, makes up the complex conception of curve-lined figures. For in this deſcending ſcale of our ideas, figure in general, plain figures, curved-lined figures, the two firſt are conſidered as genera in reſpect of the third; and the ſecond in order, or that which ſtands next to the third, is called the *neareſt genus*. But now as it is this ſecond idea, which, joined with the notion of curvity, forms the ſpecies of curve-lined figures; it is plain, that the third or laſt idea in the ſeries is made up of the neareſt genus and ſpecific difference. This rule holds invariably, however far the ſeries is continued; becauſe, in a train of ideas thus ſucceeding one another, all that precede the laſt are conſidered as ſo many genera in reſpect of that laſt; and the laſt itſelf is always formed by ſuperadding the ſpecific difference to the genus next it.

22
The idea of any individual compoſed of the loweſt ſpecies and numeric difference.

VIII. Here then we have an univerſal deſcription, applicable to all our ideas of whatever kind, from the higheſt genus to the loweſt ſpecies. For, taking them in order downwards from the ſaid general idea, they everywhere conſiſt of the *genus proximum*, and *differentia ſpecifica*, as logicians love to expreſs themſelves. But when we come to the loweſt ſpecies of all, comprehending under it only individuals, the ſuperadded idea, by which theſe individuals are diſtinguiſhed one from another, no longer takes the name of the ſpecific difference. For here it ſerves not to denote diſtinct ſpecies, but merely a variety of individuals, each of which, having a particular exiſtence of its own, is therefore numerically different from every other of the ſame kind. And hence it is, that in this laſt caſe, logicians chooſe to call the ſuperadded idea by the name of the *numerical difference;* inſomuch that, as the idea of a ſpecies is made up of the neareſt genus and ſpecific difference, ſo the idea of an individual conſiſts of the loweſt ſpecies and numeric difference. Thus the circle is a ſpecies of curve-lined figures, and what we call the *loweſt ſpecies*, as comprehending under it only individuals. Circles in particular are diſtinguiſhed from one another by the length and poſition of their diameters. The length therefore and poſition of the diameter of a circle form what logicians call the *numerical difference;* becauſe, these being given, the circle itſelf may be deſcribed, and an individual thereby conſtituted.

23
Definitions to follow one another in train and paſs through the ſame ſucceſſive gradations as our compound ideas.

IX. Thus the mind, in compounding its ideas, begins, we ſee, with the moſt general notions, which, conſiſting of but a few ſimple notices, are eaſily combined and brought together into one conception. Thence it proceeds to the ſpecies comprehended under this general idea; and theſe are formed by joining together the genus and ſpecific difference. And as it often happens, that theſe ſpecies may be ſtill farther ſubdivided, and run on in a long ſeries of continued gradations, producing various orders of compound perceptions; ſo all theſe ſeveral orders are regularly and ſucceſſively formed by annexing in every ſtep the ſpecific difference to the neareſt genus. When by this method of procedure we are come to the loweſt order of all, by joining the ſpecies and numeric difference, we frame the ideas of individuals. And here the ſeries neceſſarily terminates, becauſe it is impoſſible any farther to bound or limit our conceptions. This view of the compoſition of our ideas, repreſenting their conſtituent parts in every ſtep of the progreſſion, naturally points out the true and genuine form of a definition. For as definitions are no more than deſcriptions of the ideas for which the terms defined ſtand: and as ideas are then deſcribed, when we enumerate diſtinctly and in order the parts of which they conſiſt; it is plain, that by making our definitions follow one another according to the natural train of our conceptions, they will be ſubject to the ſame rules, and keep pace with the ideas they deſcribe.

24
The form of a definition in all the various orders of conception.

X. As therefore the firſt order of our compound notions, or the ideas that conſtitute the higheſt genera in the different ſcales of perception, are formed by uniting together a certain number of ſimple notices; ſo the terms expreſſing theſe genera are defined *by enumerating the ſimple notices ſo combined.* And as the ſpecies comprehended under any genus, or the complex ideas of the ſecond order, ariſe from ſuperadding the ſpecific difference to the ſaid general idea; ſo the definition of the names of the ſpecies is abſolved, in a detail of the ideas of the ſpecific difference, connected with the term of the genus. For the genus having been before defined, the term by which it is expreſſed ſtands for a known idea, and may therefore be introduced into all ſubſequent definitions, in the ſame manner as the names of ſimple perceptions. It will now be ſufficiently obvious, that the definitions of all the ſucceeding orders of compound notions will everywhere conſiſt of the term of the neareſt genus, joined with an enumeration of the ideas that conſtitute the ſpecific difference; and that the definition of individuals unites the name of the loweſt ſpecies with the terms by which we expreſs the ideas of the numeric difference.

XI. Here then we have the true and proper form of a definition, in all the various orders of conception. This is that method of defining which is commonly called *logical*, and which we ſee is perfect in its kind, inaſmuch as it preſents a full and adequate deſcription of the idea for which the term defined ſtands.

PART II. OF JUDGEMENT.

CHAP. I. *Of the Grounds of Human Judgement.*

25 Intuition reſpects the relations between our ideas when they are immediately perceivable.

THE mind being furniſhed with ideas, its next ſtep in the way to knowledge is, the comparing theſe ideas together, in order to judge of their agreement or diſagreement. In this joint view of our ideas, if the relation is ſuch as to be immediately diſcoverable by the bare inſpection of the mind, the judgements thence obtained are called *intuitive*, from a word that denotes *to look at;* for in this caſe, a mere attention to the ideas compared ſuffices to let us ſee now far they are connected or disjoined. Thus, *that the Whole is greater than any of its Parts*, is an intuitive judgement; nothing more being required to convince us of its truth, than an attention to the ideas of *whole* and *part*. And this too is the reaſon why we call the act of the mind forming theſe judgements *intuition;* as it is indeed no more than an immediate perception of the agreement or diſagreement of any two ideas.

26 Experience and teſtimony the ground of judging as to facts.

II. But here it is to be obſerved, that our knowledge of this kind reſpects only our ideas, and the relations between them; and therefore can ſerve only as a foundation to ſuch reaſonings as are employed in inveſtigating thoſe relations. Now it ſo happens, that many of our judgements are converſant about facts, and and the real exiſtence of things which cannot be traced by the bare contemplation of our ideas. It does not follow, becauſe I have the idea of a circle in my mind, that therefore a figure anſwering to that idea has a real exiſtence in nature. I can form to myſelf the notion of a centaur or golden mountain, but never imagine on that account that either of them exiſts. What then are the grounds of our judgement in relation to facts? *experience and teſtimony.* By experience we are informed of the exiſtence of the ſeveral objects which ſurround us, and operate upon our ſenſes. Teſtimony is of a wider extent, and reaches not only to objects beyond the preſent ſphere of our obſervation, but alſo to facts and tranſactions, which being now paſt, and having no longer any exiſtence, could not without this conveyance have fallen under our cognizance.

27 Three foundations of human judgement, *viz.* 1. Intuition, the ground of ſcientifical knowledge.

III. Here we have three foundations of human judgement, from which the whole ſyſtem of our knowledge may with eaſe and advantage be derived. Firſt, Intuition, which reſpects our ideas themſelves, and their relations; and is the foundation of that ſpecies of reaſoning which we call *demonſtration*. For whatever is deduced from our intuitive perceptions, by a clear and connected ſeries of proofs, is ſaid to be demonſtrated, and produces abſolute certainty in the mind. Hence the knowledge obtained in this manner is what we properly term *ſcience;* becauſe in every ſtep of the procedure it carries its own evidence along with it, and leaves no room for doubt or heſitation. And what is highly worthy of notice; as the truths of this claſs expreſs the relations between our ideas, and the ſame relations muſt ever and invariably ſubſiſt between the ſame ideas, our deductions in the way of ſcience conſtitute what we call *eternal*, *neceſſary*, and *immutable truths.* If it be true that the whole is equal to all its parts, it muſt be ſo unchangeably; becauſe the relation of equality being attached to the ideas themſelves, muſt ever intervene where the ſame ideas are compared. Of this nature all the truths of natural religion, morality, and mathematics, and in general whatever may be gathered from the bare view and conſideration of our ideas.

28 2. Experience, the ground of our knowledge of the powers and qualities of bodies.

IV. The ſecond ground of human judgement is *experience;* from which we infer the exiſtence of thoſe objects that ſurround us, and fall under the immediate notice of our ſenſes. When we ſeen the ſun, or caſt our eyes towards a building, we not only have perceptions of theſe objects within ourſelves, but aſcribe to them a real exiſtence out of the mind. It is alſo by the information of the ſenſes that we judge of the qualities of bodies; as when we ſay that *ſnow is white*, *fire hot*, or *ſteel hard*. For as we are wholly unacquainted with the internal ſtructure and conſtitution of the bodies that produce theſe ſenſations in us, nay, and are unable to trace any connexion between that ſtructure and the ſenſations themſelves, it is evident, that we build our judgements altogether upon obſervation, aſcribing to bodies ſuch qualities as are anſwerable to the perceptions they excite in us. Not that we ever ſuppoſe the qualities of bodies to be things of the ſame nature with our perceptions; for there is nothing in fire ſimilar to our ſenſation of heat, or in a ſword ſimilar to pain: but that when different bodies excite in our minds ſimilar perceptions, we neceſſarily aſcribe to theſe bodies not only an exiſtence independent of us, but likewiſe ſimilar qualities, of which it is the nature to produce ſimilar perceptions in the human mind. But this is not the only advantage derived from experience; for to that too we are indebted for all our knowledge regarding the co-exiſtence of ſenſible qualities in objects, and the operations of bodies one upon another. Ivory, for inſtance, is hard and elaſtic; this we know by experience, and indeed by that alone. For, being altogether ſtrangers to the true nature both of elaſticity and hardneſs, we cannot by the bare contemplation of our ideas determine how far the one neceſſarily implies the other, or whether there may not be a repugnance between them. But when we obſerve them to exiſt both in the ſame object, we are then aſſured from experience that they are not incompatible; and when we alſo find, that a ſtone is hard and not elaſtic, and that air though elaſtic

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Of Judgement.

ftic is not hard, we alfo conclude upon the fame foundation, that the ideas are not neceffarily conjoined, but may exift feparately in different objects. In like manner, with regard to the operations of bodies one upon another, it is evident, that our knowledge this way is all derived from obfervation. *Aqua regia* diffolves gold, as has been found by frequent trial, nor is there any other way of arriving at the difcovery. Naturalifts may tell us, if they pleafe, that the parts of *aqua regia* are of a texture apt to infinuate between the corpufcles of gold, and thereby loofen and fhake them afunder. If this is a true account of the matter, it will notwithftanding be allowed, that our conjecture in regard to the conformation of thefe bodies is deduced from the experiment, and not the experiment from the conjecture. It was not from any previous knowledge of the intimate ftructure of *aqua regia* and *gold*, and the aptnefs of their parts to act or to be acted upon, that we came by the conclufion above mentioned. The internal conftitution of bodies is in a manner wholly unknown to us: and could we even furmount this difficulty, yet as the feparation of the parts of gold implies fomething like an active force in the *menftruum*, and we are unable to conceive how it comes to be poffeffed of this activity, the effect muft be owned to be altogether beyond our comprehenfion. But when repeated trials had once confirmed it, infomuch that it was admitted as an eftablifhed truth in natural knowledge, it was then eafy for men to fpin out theories of their own invention, and contrive fuch a ftructure of parts, both for *gold* and *aqua regia*, as would beft ferve to explain the phenomenon upon the principles of that fyftem of philofophy they had adopted.

V. From what has been faid it is evident, that as intuition is the foundation of what we call *fcientifical* knowledge, fo is experience of *natural*. For this laft being wholly taken up with objects of fenfe, or thofe bodies that conftitute the natural world; and their properties, as far as we can difcover them, being to be traced only by a long and painful feries of obfervations; it is apparent, that, in order to improve this branch of knowledge, we muft betake ourfelves to the method of trial and experiment.

VI. But though experience is what we may term the immediate foundation of natural knowledge, yet with refpect to particular perfons its influence is very narrow and confined. The bodies that furround us are numerous, many of them lie at a great diftance, and fome quite beyond our reach. Life is fo fhort, and fo crowded with cares, that but little time is left for any fingle man to employ himfelf in unfolding the myfteries of nature. Hence it is neceffary to admit many things upon the teftimony of others, which by this means becomes the foundation of a great part of our knowledge of body. No man doubts of the power of *aqua regia* to diffolve gold, though perhaps he never himfelf made the experiment. In thefe therefore and fuch like cafes we judge of the facts and operations of nature upon the mere ground of teftimony. However, as we can always have recourfe to experience where any doubt or fcruple arifes, this is juftly confidered as the true foundation of natural philofophy; being indeed the ultimate fupport upon which our affent refts, and whereto we appeal when the higheft degree of evidence is required.

Of Judgement.

29
3. Teftimony, the ground of hiftorical knowledge.

VII. But there are many facts that will not allow of an appeal to the fenfes; and in this cafe teftimony is the true and only foundation of our judgments. All human actions of whatever kind, when confidered as already paft, are of the nature here defcribed; becaufe having now no longer any exiftence, both the facts themfelves, and the circumftances attending them, can be known only from the relations of fuch as had fufficient opportunities of arriving at the truth. *Teftimony* therefore is juftly accounted a third ground of human judgement; and as from the other two we have deduced *fcientifical* and *natural* knowledge, fo we may from this derive *hiftorical*; by which we mean, not merely a knowledge of the civil tranfactions of ftates and kingdoms, but of all facts whatfoever, where teftimony is the ultimate foundation of our belief.

Chap. II. *Of Affirmative and Negative Propofitions.*

30
The fubject and predicate of a propofition explained.

I. While the comparing of our ideas is confidered merely as an act of the mind, affembling them together, and joining or disjoining them according to the refult of its perceptions, we call it *judgement;* but when our judgements are put into words, they then bear the name of *propofitions*. A propofition therefore is a fentence expreffing fome judgement of the mind, whereby two or more ideas are affirmed to agree or difagree. Now, as our judgements include at leaft two ideas, one of which is affirmed or denied of the other, fo muft a propofition have terms anfwering to thefe ideas. The idea of which we affirm or deny, and of courfe the term expreffing that idea, is called the *fubject* of the propofition. The idea affirmed or denied, as alfo the term anfwering it, is called the *predicate*. Thus in the propofition, *God is omnipotent: God* is the fubject, it being of him that we affirm omnipotence; and *omnipotent* is the predicate, becaufe we affirm the idea expreffed by that word to belong to God.

31
The copula, &c.

II. But as, in propofitions, ideas are either joined or disjoined; it is not enough to have terms expreffing thofe ideas, unlefs we have alfo fome words to denote their agreement or difagreement. That word in a propofition, which connects two ideas together, is called the *copula;* and if a negative particle be annexed, we thereby underftand that the ideas are disjoined. The *fubftantive verb* is commonly made ufe of for the copula: as in the above mentioned propofition, *God is omnipotent;* where *is* reprefents the copula, and fignifies the agreement of the ideas of *God* and *omnipotence*. But if we mean to feparate two ideas; then, befides the fubftantive verb, we muft alfo ufe fome particle of negation, to exprefs this repugnance. The propofition, *man is not perfect*, may ferve as an example of this kind; where the notion of *perfection* being removed from the idea of *man*, the negative particle *not* is inferted after the copula, to fignify the difagreement between the fubject and predicate.

32
Propofitions fometimes expreffed by a fingle word.

III. Every propofition neceffarily confifts of thefe three parts; but then it is not alike needful that they be all feverally expreffed in words; becaufe the copula is often included in the term of the predicate, as when we

Of Judgement.

we say, *he sits*; which imports the same as *he is sitting*. In the Latin language, a single word has often the force of a whole sentence. Thus *ambulat* is the same as *ille est ambulans*; *amo*, as *ego sum amans*; and so in innumerable other instances: by which it appears, that we are not so much to regard the number of words in a sentence, as the ideas they represent, and the manner in which they are put together. For wherever two ideas are joined or disjoined in an expression, though of but a single word; it is evident that we have a subject, predicate, and copula, and of consequence a complete proposition.

33 Affirmative and negative propositions.

IV. When the mind joins two ideas, we call it an *affirmative* judgement; when it separates them, *a negative*; and as any two ideas compared together must necessarily either agree or not agree, it is evident that all our judgements fall under these two divisions. Hence likewise the propositions expressing these judgements are all either affirmative or negative. An affirmative proposition connects the predicate with the subject, as *a stone is heavy*; a negative proposition separates them, as *God is not the author of evil*. *Affirmation* therefore is the same as joining two ideas together; and this is done by means of the copula. *Negation*, on the contrary, marks the repugnance between the ideas compared; in which case a negative particle must be called in, to show that the connexion included in the copula does not take place.

34 When the negative particle serves to disjoin ideas.

V. Hence we see the reason of the rule commonly laid down by logicians, That in all negative propositions the negation ought to affect the copula. For as the copula, when placed by itself, between the subject and the predicate, manifestly binds them together; it is evident, that in order to render a proposition negative, the particles of negation must enter it in such a manner as to destroy this union. In a word, then only are two ideas disjoined in a proposition, when the negative particle may be so referred to the copula, as to break the affirmation included in it, and undo that connexion it would otherwise establish. When we say, for instance, *No man is perfect*; take away the negation, and the copula of itself plainly unites the ideas in the proposition. But as this is the very reverse of what is intended, a negative mark is added, to show that this union does not here take place. The negation, therefore, by destroying the effect of the copula, changes the very nature of the proposition, insomuch that, instead of binding two ideas together, it denotes their separation. On the contrary, in this sentence, *The man who departs not from an upright behaviour is beloved of God*, the predicate *beloved of God* is evidently affirmed of the subject an *upright man*: so that, notwithstanding the negative particle, the proposition is still affirmative. The reason is plain: the negation here affects not the copula; but, making properly a part of the subject, serves, with other terms in the sentence, to form one complex idea, of which the predicate *beloved of God* is directly affirmed.

Chap. III. *Of Universal and Particular Propositions.*

35 Division of propositions into universal and particular.

I. The next considerable division of propositions is into *universal* and *particular*. Our ideas, according to what has been already observed in the First Part, are all singular as they enter the mind, and represent individual objects. But as by abstraction we can render them universal, so as to comprehend a whole class of things, and sometimes several classes at once; hence the terms expressing these ideas must be in like manner universal. If therefore we suppose any general term to become the subject of a proposition, it is evident, that whatever is affirmed of the abstract idea belonging to that term, may be affirmed of all the individuals to which that idea extends. Thus, when we say, *Men are mortal*; we consider mortality, not as confined to one or any number of particular men, but as what may be affirmed without restriction of the whole species. By this means the proposition becomes as general as the idea which makes the subject of it; and indeed derives its universality entirely from that idea, being more or less so according as this may be extended to more or fewer individuals. But it is further to be observed of these general terms, that they sometimes enter a proposition in their full latitude, as in the example given above; and sometimes appear with a mark of limitation. In this last case we are given to understand, that the predicate agrees not to the whole universal idea, but only to a part of it; as in the proposition, *Some men are wise*: For here wisdom is not affirmed of every particular man, but restrained to a few of the human species (B).

36 Propositions universal where the subject is so, without a mark of restriction.

II. Now from this different appearance of the general idea that constitutes the subject of any judgement, arises the division of propositions into *universal* and *particular*. An universal proposition is that wherein the subject is some general term taken in its full latitude; insomuch that the predicate agrees to all the individuals comprehended under it, if it denotes a proper species; and to all the several species, and their individuals, if it marks an idea of a higher order. The words *all*, *every*, *no*, *none*, &c. are the proper signs of this universality; and as they seldom fail to accompany general truths, so they are the most obvious criterion whereby to distinguish them. *All animals have a power of beginning motion.* This is an universal proposition; as we know from the word *all* prefixed to the subject *animals*, which denotes that it must be taken in its full extent. Hence the power of beginning motion may be affirmed of all the several species of animals.

37 Propositions particular where some universal subject appears with a mark of limitation.

III. A *particular* proposition has in like manner some general term for its subject; but with a mark of limitation

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(B) See the preceding note, where it is demonstrated that the *terms* alone, and not the *ideas*, are in reality *general*. The term *man* is equally applicable to every individual of the human race; and therefore, what is affirmed or denied of *men* in general, is affirmed or denied of all the individuals, without regard to their discriminating qualities. *Some* is a definitive word (see Grammar), which, prefixed to the word *man*, limits the signification of that *general term*; and therefore what is affirmed of *some men*, is affirmed only of *part* of the race, but that part itself is not ascertained.

Of Judgement.

limitation added, to denote, that the predicate agrees only to ſome of the individuals comprehended under a ſpecies, or to one or more of the ſpecies belonging to any genus, and not to the whole univerſal idea. Thus, *Some ſtones are heavier than iron; Some men have an uncommon ſhare of prudence.* In the laſt of theſe propoſitions, the ſubject *ſome men* implies only a certain number of individuals, comprehended under a ſingle ſpecies. In the former, where the ſubject is a genus that extends to a great variety of diſtinct claſſes, *ſome ſtones* may not only imply any number of particular ſtones, but alſo ſeveral whole ſpecies of ſtones, inaſmuch as there may be not a few with the property there deſcribed. Hence we ſee, that a propoſition does not ceaſe to be particular by the predicate's agreeing to a whole ſpecies, unleſs that ſpecies, ſingly and diſtinctly conſidered, makes alſo the ſubject of which we affirm or deny.

38 Singular propoſitions contained under the head of particulars.

IV. There is ſtill one ſpecies of propoſitions that remains to be deſcribed, and which the more deſerves our notice, as it is not yet agreed among logicians to which of the two claſſes mentioned above they ought to be referred; namely, *ſingular* propoſitions, or thoſe where the ſubject is an individual. Of this nature are the following: *Sir Iſaac Newton was the inventor of fluxions; This book contains many uſeful truths.* What occaſions ſome difficulty as to the proper rank of theſe propoſitions is, that, the ſubject being taken according to the whole of its extenſion, they ſometimes have the ſame effect in reaſoning as univerſals. But if it be conſidered that they are in truth the moſt limited kind of particular propoſitions, and that no propoſition can with any propriety be called univerſal but where the ſubject is ſome univerſal idea; we ſhall not be long in determining to which claſs they ought to be referred. When we ſay, *Some books contain uſeful truths;* the propoſition is particular, becauſe the general term appears with a mark of reſtriction. If therefore we ſay, *This book contains uſeful truths;* it is evident that the propoſition muſt be ſtill more particular, as the limitation implied in the word *this*, is of a more confined nature than in the former caſe.

39 The fourfold diviſion of propoſitions.

V. We ſee, therefore, that all propoſitions are either *affirmative* or *negative;* nor is it leſs evident, that in both caſes they may be *univerſal* or *particular*. Hence ariſes that celebrated fourfold diviſion of them into *univerſal affirmative* and *univerſal negative, particular affirmative* and *particular negative*, which comprehends indeed all their varieties. The uſe of this method of diſtinguiſhing them will appear more fully afterwards, when we come to treat of reaſoning and ſyllogiſm.

Chap. IV. *Of Abſolute and Conditional Propoſitions.*

40 Diſtinction of qualities into eſſential and accidental.

I. The objects about which we are chiefly converſant in this world, are all of a nature liable to change. What may be affirmed of them at one time, cannot often at another; and it makes no ſmall part of our knowledge to diſtinguiſh rightly theſe variations, and trace the reaſons upon which they depend. For it is obſervable, that amidſt all the viciſſitudes of nature, ſome things remain conſtant and invariable; nor even are the changes, to which we ſee others liable, effected but in conſequence of uniform and ſteady laws, which, when known, are ſufficient to direct us in our judgements about them. Hence philoſophers, in diſtinguiſhing the objects of our perception into various claſſes, have been very careful to note, that ſome properties belong eſſentially to the general idea, ſo as not to be ſeparable from it but by deſtroying its very nature; while others are only accidental, and may be affirmed or denied of it in different circumſtances. Thus ſolidity, a yellow colour, and great weight, are conſidered as eſſential qualities of gold: but whether it ſhall exiſt as an uniform conjoined maſs, is not alike neceſſary. We ſee that by a proper menſtruum it may be reduced to a fine powder, and that an intenſe heat will bring it into a ſtate of fuſion.

41 Hence a conſiderable diverſity in our manner of judging.

II. From this diverſity in the ſeveral qualities of things ariſes a conſiderable difference as to the manner of our judging about them. For all ſuch properties as are inſeparable from objects when conſidered as belonging to any genus or ſpecies, are affirmed abſolutely and without reſerve of that general idea. Thus we ſay, *Gold is very weighty; A ſtone is hard; Animals have a power of ſelf-motion.* But in the caſe of mutual or accidental qualities, as they depend upon ſome other conſideration diſtinct from the general idea; that alſo muſt be taken into the account, in order to form an accurate judgement. Should we affirm, for inſtance, of ſome ſtones, that they are very ſuſceptible of a rolling motion; the propoſition, while it remains in this general form, cannot with any advantage be introduced into our reaſonings. An aptneſs to receive that mode of motion flows from the figure of the ſtone; which, as it may vary infinitely, our judgement then only becomes applicable and determinate, when the particular figure, of which volubility is a conſequence, is alſo taken into the account. Let us then bring in this other conſideration, and the propoſition will run as follows: *Stones of a ſpherical form are eaſily put into a rolling motion.* Here we ſee the condition upon which the predicate is affirmed, and therefore know in what particular caſes the propoſition may be applied.

42 Which gives riſe to the diviſion of propoſitions into abſolute and conditional.

III. This conſideration of propoſitions reſpecting the manner in which the predicate is affirmed of the ſubject gives riſe to the diviſion of them into *abſolute* and *conditional*. *Abſolute* propoſitions are thoſe wherein we affirm ſome property inſeparable from the idea of the ſubject, and which therefore belongs to it in all poſſible caſes: as, *God is infinitely wiſe; Virtue tends to the ultimate happineſs of man.* But where the predicate is not neceſſarily connected with the idea of the ſubject, unleſs upon ſome conſideration diſtinct from that idea, there the propoſition is called *conditional*. The reaſon of the name is taken from the ſuppoſition annexed, which is of the nature of a condition, and may be expreſſed as ſuch, thus: *If a ſtone is expoſed to the rays of the ſun, it will contract ſome degree of heat; If a river runs in a very declining channel, its rapidity will conſtantly increaſe.*

43 The great importance of this diviſion, as it renders propoſitions determinate.

IV. There is not any thing of greater importance in philoſophy than a due attention to this diviſion of propoſitions. If we are careful never to affirm things abſolutely but where the ideas are inſeparably conjoined; and if in our other judgements we diſtinctly mark the conditions which determine the predicate to belong to the ſubject; we ſhall be the leſs liable to

miſtake

Of Judgement.

miſtake in applying general truths to the particular concerns of human life. It is owing to the exact obſervance of this rule that mathematicians have been ſo happy in their diſcoveries, and that what they demonſtrate of magnitude in general may be applied with eaſe in all obvious occurrences.

44 And reduces them from particulars to generals.

V. The truth of it is, particular propoſitions are then known to be true, when we can trace their connexion with univerſals; and it is accordingly the great buſineſs of ſcience to find out general truths that may be applied with ſafety in all obvious inſtances. Now the great advantage ariſing from determining with care the conditions upon which one idea may be affirmed or denied of another is this: that thereby particular propoſitions really become univerſal, may be introduced with certainty into our reaſonings, and ſerve as ſtandards to conduct and regulate our judgements. To illuſtrate this by a familiar inſtance: if we ſay, *Some water acts very forcibly;* the propoſition is particular: and as the conditions on which this forcible action depends are not mentioned, it is as yet uncertain in what caſes it may be applied. Let us then ſupply theſe conditions, and the propoſition will run thus: *Water conveyed in ſufficient quantity along a ſteep deſcent acts very forcibly.* Here we have an univerſal judgement, inaſmuch as the predicate *forcible action* may be aſcribed to all water under the circumſtances mentioned. Nor is it leſs evident that the propoſition in this new form is of eaſy application; and in fact we find that men do apply it in inſtances where the forcible action of water is required; as in corn-mills and many other works of art.

Chap. V. *Of Simple and Compound Propoſitions.*

45 Diviſion of propoſitions into ſimple and compound.

I. Hitherto we have treated of propoſitions, where only two ideas are compared together. Theſe are in the general called *ſimple;* becauſe, having but one ſubject and one predicate, they are the effect of a ſimple judgement that admits of no ſubdiviſion. But if it ſo happens that ſeveral ideas offer themſelves to our thoughts at once, whereby we are led to affirm the ſame thing of different objects, or different things of the ſame object; the propoſitions expreſſing theſe judgements are called *compound:* becauſe they may be reſolved into as many others as there are ſubjects or predicates in the whole complex determination on the mind. Thus, *God is infinitely wiſe and infinitely powerful.* Here there are two predicates, *infinite wiſdom and infinite power*, both affirmed of the ſame ſubject; and accordingly the propoſition may be reſolved into two others; affirming theſe predicates ſeverally. In like manner in the propoſition, *Neither kings nor people are exempt from death;* the predicate is denied of both ſubjects, and may therefore be ſeparated from them in diſtinct propoſitions. Nor is it leſs evident, that if a complex judgement conſiſts of ſeveral ſubjects and predicates, it may be reſolved into as many ſimple propoſitions as are the number of different ideas compared together. *Riches and honours are apt to elate the mind, and increaſe the number of our deſires.* In this judgement there are two ſubjects and two predicates, and it is at the ſame time apparent that it may be reſolved into four diſtinct propoſitions. *Riches are apt to elate the mind. Riches are apt to increaſe the number of our deſires.* And ſo of honours.

46. The proper notion of a compound propoſition aſcertained.

II. Logicians have divided theſe compound propoſitions into a great many different claſſes; but, in our opinion, not with a due regard to their proper definition. Thus *conditionals, cauſals, relatives*, &c. are mentioned as ſo many diſtinct ſpecies of this kind, though in fact they are no more than ſimple propoſitions. To give an inſtance of a conditional; *If a ſtone is expoſed to the rays of the ſun, it will contract ſome degree of heat.* Here we have but one ſubject and one predicate; for the complex expreſſion, *A ſtone expoſed to the rays of the ſun*, conſtitutes the proper ſubject of this propoſition, and is no more than one determined idea. The ſame thing happens in cauſals. *Rehoboam was unhappy becauſe he followed evil counſel* There is here an appearance of two propoſitions ariſing from the complexity of the expreſſion; but when we come to conſider the matter more nearly, it is evident that we have but a ſingle ſubject and predicate. *The purſuit of evil counſel brought miſery upon Rehoboam.* It is not enough, therefore, to render a propoſition compound, that the ſubject and predicate are complex notions, requiring ſometimes a whole ſentence to expreſs them: for in this caſe the compariſon is ſtill confined to two ideas, and conſtitutes what we call a ſimple judgement. But where there are ſeveral ſubjects or predicates, or both, as the affirmation or negation may be alike extended to them all, the propoſition expreſſing ſuch a judgement is truly a collection of as many ſimple ones as there are different ideas compared. Confining ourſelves therefore to this more ſtrict and juſt notion of compound propoſitions, they are all reducible to two kinds, viz. *copulatives* and *disjunctives*.

47 Compound propoſitions, either copulative,

III. A *copulative* propoſition is, where the ſubjects and predicates are ſo linked together, that they may be all ſeverally affirmed or denied one of another. Of this nature are the examples of compound propoſitions given above. *Riches and honours are apt to elate the mind, and increaſe the number of our deſires. Neither kings nor people are exempt from death.* In the firſt of theſe the two predicates may be affirmed ſeverally of each ſubject, whence we have four diſtinct propoſitions. The other furniſhes an example of the negative kind, where the ſame predicate, being disjoined from both ſubjects, may be alſo denied of them in ſeparate propoſitions.

48 or disjunctive.

IV. The other ſpecies of compound propoſitions are thoſe called disjunctives; in which, comparing ſeveral predicates with the ſame ſubject, we affirm that one of them neceſſarily belongs to it, but leave the particular predicate undetermined. If any one, for example, ſays, *This world either exiſts of itſelf, or is the work of ſome all-wiſe and powerful cauſe*, it is evident that one of the two predicates muſt belong to the world; but as the propoſition determines not which, it is therefore of the kind we call *disjunctive*. Such too are the following: *The ſun either moves round the earth, or is the centre about which the earth revolves. Friendſhip finds men equal, or makes them ſo.* It is the nature of all propoſitions of this claſs, ſuppoſing them to be exact in point of form, that upon determining the particular predicate, the reſt are of courſe to be removed: or if all

Of Judgement.

all the predicates but one are removed, that one neceſſarily takes place. Thus, in the example given above; if we allow the world to be the work of ſome wiſe and powerful cauſe, we of courſe deny it to be ſelf-exiſtent; or if we deny it to be ſelf-exiſtent, we muſt neceſſarily admit that it was produced by ſome wiſe and powerful cauſe. Now this particular manner of linking the predicates together, ſo that the eſtabliſhing one diſplaces all the reſt; or the excluding all but one neceſſarily eſtabliſhes that one; cannot otherwiſe be effected than by means of *disjunctive* particles. And hence it is that propoſitions of this claſs take their names from theſe particles which make ſo neceſſary a part of them, and indeed conſtitute their very nature conſidered as a diſtinct ſpecies.

CHAP. VI. *Of the Diviſion of Propoſitions into Self-evident and Demonſtrable.*

49 Propoſitions divided into ſelf-evident and demonſtrable.

I. WHEN any propoſition is offered to the view of the mind, if the terms in which it is expreſſed be underſtood; upon comparing the ideas together, the agreement or diſagreement aſſerted is either immediately perceived, or found to lie beyond the preſent reach of the underſtanding. In the firſt caſe the propoſition is ſaid to be *ſelf-evident*, and admits not of any proof, becauſe a bare attention to the ideas themſelves produces full conviction and certainty; nor is it poſſible to call in any thing more evident by way of confirmation. But where the connexion or repugnance comes not ſo readily under the inſpection of the mind, there we muſt have recourſe to reaſoning; and if by a clear ſeries of proofs we can make out the truth propoſed, inſomuch that ſelf-evidence ſhall accompany every ſtep of the procedure, we are then able to demonſtrate what we aſſert, and the propoſition itſelf is ſaid to be *demonſtrable*. When we affirm, for inſtance, *that it is impoſſible for the ſame thing to be and not to be*; whoever underſtands the terms made uſe of perceives at firſt glance the truth of what is aſſerted, nor can he by any efforts bring himſelf to believe the contrary. The propoſition therefore is *ſelf-evident*, and ſuch that it is impoſſible by reaſoning to make it plainer; becauſe there is no truth more obvious or better known, from which as a conſequence it may be deduced. But if we ſay, *This world had a beginning*; the aſſertion is indeed equally true, but ſhines not forth with the ſame degree of evidence. We find great difficulty in conceiving how the world could be made out of nothing: and are not brought to a free and full conſent, until by reaſoning we arrive at a clear view of the abſurdity involved in the contrary ſuppoſition. Hence this propoſition is of the kind we call *demonſtrable*, inaſmuch as its truth is not immediately perceived by the mind, but yet may be made appear by means of others more known and obvious, whence it follows as an unavoidable conſequence.

50 Self-evident truths the firſt principles of reaſoning.

II. From what has been ſaid, it appears, that reaſoning is employed only about demonſtrable propoſitions, and that our intuitive and ſelf-evident perceptions are the ultimate foundation on which it reſts.

III. Self-evident propoſitions furniſh the firſt principles of reaſoning; and it is certain, that if in our reſearches we employ only ſuch principles as have this character of ſelf-evidence, and apply them according to the rules to be afterwards explained, we ſhall be in no danger of error in advancing from one diſcovery to another. For this we may appeal to the writings of the mathematicians, which, being conducted by the expreſs model here mentioned, are an inconteſtable proof of the firmneſs and ſtability of human knowledge, when built upon ſo ſure a foundation. For not only have the propoſitions of this ſcience ſtood the teſt of ages; but are found attended with that invincible evidence, as forces the aſſent of all who duly conſider the proofs upon which they are eſtabliſhed. Since the mathematicians are univerſally allowed to have hit upon the right method of arriving at unknown truths, ſince they have been the happieſt in the choice as well as the application of their principles, it may not be amiſs to explain here their method of ſtating ſelf-evident propoſitions, and applying them to the purpoſes of demonſtration.

51 Definitions a great help to clearneſs and evidence in knowledge.

IV. Firſt then it is to be obſerved, that they have been very careful in aſcertaining their ideas, and fixing the ſignification of their terms. For this purpoſe they begin with *definitions*, in which the meaning of their words is ſo diſtinctly explained, that they cannot fail to excite in the mind of an attentive reader the very ſame ideas as are annexed to them by the writer. And indeed the clearneſs and irreſiſtible evidence of mathematical knowledge is owing to nothing ſo much as this care in laying the foundation. Where the relation between any two ideas is accurately and juſtly traced, it will not be difficult for another to comprehend that relation, if in ſetting himſelf to diſcover it he brings the very ſame ideas into compariſon. But if, on the contrary, he affixes to his words ideas different from thoſe that were in the mind of him who firſt advanced the demonſtration; it is evident that as the ſame ideas are not compared, the ſame relation cannot ſubſiſt, inſomuch that a propoſition will be rejected as falſe, which, had the terms been rightly underſtood, muſt have appeared inconteſtably true. A ſquare, for inſtance, is a figure bounded by four equal right lines, joined together at right angles. Here the nature of the angles makes no leſs a part of the idea than the equality of the ſides: and many properties demonſtrated of the ſquare flow entirely from its being a rectangular figure. If therefore we ſuppoſe a man, who has formed a partial notion of a ſquare, comprehending only the equality of its ſides, without regard to the angles, reading ſome demonſtration that implies alſo this latter conſideration; it is plain he would reject it as not univerſally true, inaſmuch as it could not be applied where the ſides were joined together at equal angles. For this laſt figure, anſwering ſtill to his idea of a ſquare, would be yet found without the property aſſigned to it in the propoſition. But if he comes afterwards to correct his notion, and render his idea complete, he will then readily own the truth and juſtneſs of the demonſtration.

52 Mathematicians, by beginning with them procure a ready reception to the truths they advance.

V. We ſee, therefore, that nothing contributes ſo much to the improvement and certainty of human knowledge, as the having determinate ideas, and keeping them ſteady and invariable in all our diſcourſes and reaſonings about them. And on this account it is, that mathematicians, as was before obſerved, always

Of Judgement.

always begin by defining their terms, and diſtinctly unfolding the notions they are intended to expreſs. Hence ſuch as apply themſelves to theſe ſtudies have exactly the ſame views of things: and, bringing always the very ſame ideas into compariſon, readily diſcern the relations between them. It is likewiſe of importance, in every demonſtration, to expreſs the ſame *idea* invariably by the ſame word. From this practice mathematicians never deviate; and if it be neceſſary in their demonſtrations, where the reader's comprehenſion is *aided* by a diagram, it is much more ſo in all reaſonings about moral or intellectual truths where the ideas cannot be repreſented by a diagram. The obſervation of this rule may ſometimes be productive of ill-ſounding periods; but when *truth* is the object, *ſound* ought to be deſpiſed.

53 The eſtabliſhing of principles, the ſecond ſtep in mathematical knowledge.

VI. When the mathematicians have taken this firſt ſtep, and made known the ideas whoſe relations they intend to inveſtigate; their next care is, to lay down ſome ſelf-evident truths, which may ſerve as a foundation for their future reaſonings. And here indeed they proceed with remarkable circumſpection, admitting no principles but what flow immediately from their definitions, and neceſſarily force themſelves upon a mind in any degree attentive to its ideas. Thus a *circle* is a figure formed by a right line moving round ſome fixed point in the ſame plane. The fixed point round which the line is ſuppoſed to move, and where one of its extremities terminates, is called the *centre* of the circle. The other extremity, which is conceived to be carried round until it returns to the point whence it firſt ſet out, deſcribes a curve running into itſelf, and termed the *circumference*. All right lines drawn from the centre to the circumference are called *radii*. From theſe definitions compared, geometricians derive this ſelf-evident truth; *that the radii of the ſame circle are all equal to one another*.

54 Propoſitions divided into ſpeculative and practical.

VII. We now obſerve, that in all propoſitions we either affirm or deny ſome property of the idea that conſtitutes the ſubject of our judgement, or we maintain that ſomething may be done or effected. The firſt ſort are called *ſpeculative* propoſitions, as in the example mentioned above, the *radii of the ſame circle are all equal one to another*. The others are called *practical*, for a reaſon too obvious to be mentioned; thus, *that a right line may be drawn from one point to another* is a practical propoſition; inaſmuch as it expreſſed that ſomething may be done.

55 Hence mathematical principles diſtinguiſhed into axioms and poſtulates;

VIII. From this twofold conſideration of propoſitions ariſes the twofold diviſion of mathematical principles into axioms and poſtulates. By an *axiom* they underſtand any ſelf-evident ſpeculative truth; as, *That the whole is greater than its parts: That things equal to one and the ſame thing are equal to one another*. But a ſelf-evident practical propoſition is what they call a *poſtulate*. Such are thoſe of Euclid; *that a finite right line may be continued directly forwards; that a circle may be deſcribed about any centre with any diſtance*. And here we are to obſerve, that as in an axiom the agreement or diſagreement between the ſubject and predicate muſt come under the immediate inſpection of the mind; ſo in a poſtulate, not only the poſſibility of the thing aſſerted muſt be evident at firſt view, but alſo the manner in which it may be effected. For where this manner is not of itſelf apparent, the propoſition comes under the notion of the demonſtrable kind and is treated as ſuch by geometrical writers. Thus, *to draw a right line from one point to another*, is aſſumed by Euclid as a poſtulate, becauſe the manner of doing it is ſo obvious, as to require no previous teaching. But then it is not equally evident, how we are to conſtruct an equilateral triangle. For this reaſon he advances it as a demonſtrable propoſition, lays down rules for the exact performance, and at the ſame time proves, that if theſe rules are followed, the figure will be juſtly deſcribed.

56 and demonſtrable propoſitions into theorems and problems.

IX. This leads us to take notice, that as ſelf-evident truths are diſtinguiſhed into different kinds, according as they are ſpeculative or practical; ſo is it alſo with demonſtrable propoſitions. A demonſtrable ſpeculative propoſition is by mathematicians called a *theorem*. Such is the famous 47th propoſition of the firſt book of the Elements, known by the name of the *Pythagoric theorem*, from its ſuppoſed inventor Pythagoras, viz. "that in every right-angled triangle, the ſquare deſcribed upon the ſide ſubtending the right angle is equal to both the ſquares deſcribed upon the ſides containing the right angle." On the other hand, a demonſtrable practical propoſition is called a *problem;* as where Euclid teaches us to deſcribe a ſquare upon a given right line.

57 Corollaries are obvious deductions from theorems or problems.

X. It may not be amiſs to add, that, beſides the four kinds of propoſitions already mentioned, mathematicians have alſo a fifth, known by the name of *corollaries*. Theſe are uſually ſubjoined to theorems or problems, and differ from them only in this: that they flow from what is there demonſtrated in ſo obvious a manner as to diſcover their dependence upon the propoſition whence they are deduced, almoſt as ſoon as propoſed. Thus Euclid having demonſtrated, "that in every right-lined triangle all the three angles taken together are equal to two right angles;" adds by way of corollary, "that all the three angles of any one triangle taken together are equal to all the three angles of any other triangle taken together: which is evident at firſt ſight; becauſe in all caſes they are equal to two right ones, and things equal to one and the ſame thing are equal to one another.

58 Scholia ſerve the purpoſes of annotations or a comment.

XI. The ſcholia of mathematicians are indifferently annexed to definitions, propoſitions, or corollaries; and anſwer the ſame purpoſes as annotations upon a claſſic author. For in them occaſion is taken to explain whatever may appear intricate and obſcure in a train of reaſoning; to anſwer objections; to teach the application and uſes of propoſitions; to lay open the original and hiſtory of the ſeveral diſcoveries made in the ſcience; and, in a word, to acquaint us with all ſuch particulars as deſerve to be known, whether conſidered as points of curioſity or profit.

PART III. OF REASONING.

Chap. I. *Of Reaſoning in general, and the Parts of which it conſiſts.*

IT often happens in comparing ideas together, that their agreement or diſagreement cannot be diſcerned at firſt view, eſpecially if they are of ſuch a nature as not to admit of an exact application one to another.

59
Remote relations diſcovered by means of intermediate ideas.

When, for inſtance, we compare two figures of a different make, in order to judge of their equality or inequality, it is plain, that by barely conſidering the figures themſelves, we cannot arrive at an exact determination; becauſe, by reaſon of their diſagreeing forms, it is impoſſible ſo to put them together, as that their ſeveral parts ſhall mutually coincide. Here then it becomes neceſſary to look out for ſome third idea that will admit of ſuch an application as the preſent caſe requires; wherein if we ſucceed, all difficulties vaniſh, and the relation we are in queſt of may be traced with eaſe. Thus, right-lined figures are all reduced to ſquares, by means of which we can meaſure their areas, and determine exactly their agreement or diſagreement in point of magnitude.

60
This manner of arriving at truth termed reaſoning.

II. But how can any third idea ſerve to diſcover a relation between two others? The anſwer is, By being compared ſeverally with theſe others; for ſuch a compariſon enables us to ſee how far the ideas with which this third is compared are connected or disjoined between themſelves. In the example mentioned above of two right-lined figures, if we compare each of them with ſome ſquare whoſe area is known, and find the one exactly equal to it, and the other leſs by a ſquare inch, we immediately conclude that the area of the firſt figure is a ſquare inch greater than that of the ſecond. This manner of determining the relation between any two ideas, by the intervention of ſome third with which they may be compared, is that which we call *reaſoning;* and is indeed the chief inſtrument by which we puſh on our diſcoveries, and enlarge our knowledge. The great art lies in finding out ſuch intermediate ideas, as when compared with the others in the queſtion, will furniſh evident and known truths; becauſe, as will afterwards appear, it is only by means of them that we arrive at the knowledge of what is hidden and remote.

61
The parts that conſtitute an act of reaſoning and a ſyllogiſm.

III. Hence it appears, that every act of reaſoning neceſſarily includes three diſtinct judgements; two wherein the ideas whoſe relation we want to diſcover are ſeverally compared with the middle idea, and a third wherein they are themſelves connected or disjoined, according to the reſult of that compariſon. Now, as in the ſecond part of logic, our judgements, when put into words, were called propoſitions, ſo here in the third part the expreſſions of our reaſonings are termed *ſyllogiſms*. And hence it follows, that as every act of reaſoning implies three ſeveral judgements, ſo every ſyllogiſm muſt include three diſtinct propoſitions. When a reaſoning is thus put into words, and appears in form of a ſyllogiſm, the intermediate idea made uſe of, to diſcover the agreement or diſagreement we ſearch for, is called the *middle term;* and the two ideas themſelves with which this third is compared, go by the name of the *extremes.*

62
Inſtance, man and accountableneſs.

VI. But as theſe things are beſt illuſtrated by examples; let us, for inſtance, ſet ourſelves to inquire *whether men are accountable for their actions.* As the relation between the ideas of *man* and *accountableneſs,* comes not within the immediate view of the mind, our firſt care muſt be to find out ſome third idea that will enable us the more eaſily to diſcover and trace it. A very ſmall meaſure of reflection is ſufficient to inform us, that no creature can be accountable for his actions, unleſs we ſuppoſe him capable of diſtinguiſhing the good from the bad; that is, unleſs we ſuppoſe him poſſeſſed of reaſon. Nor is this alone ſufficient. For what would it avail him to know good from bad actions, if he had no freedom of choice, nor could avoid the one and purſue the other? hence it becomes neceſſary to take in both conſiderations in the preſent caſe. It is at the ſame time equally apparent, that wherever there is ability of diſtinguiſhing good from bad actions, and of purſuing the one and avoiding the other, there alſo a creature is accountable. We have then got a third idea, with which *accountableneſs* is inſeparably connected, viz. *reaſon and liberty;* which are here to be conſidered as making up one complex conception. Let us now take this middle idea, and compare it with the other term in the queſtion, viz. *man,* and we all know by experience that it may be affirmed of him. Having thus by means of the intermediate idea formed two ſeveral judgements, viz. *that man is poſſeſſed of reaſon and liberty;* and *that reaſon and liberty imply accountableneſs;* a third obviouſly and neceſſarily follows, viz. *that man is accountable for his actions.* Here then we have a complete act of reaſoning, in which, according to what has been already obſerved, there are three diſtinct judgements: two that may be ſtyled previous, inaſmuch as they lead to the other, and ariſe from comparing the middle idea with the two ideas in the queſtion: the third is a conſequence of theſe previous acts, and flows from combining the extreme ideas between themſelves. If now we put this reaſoning into words, it exhibits what logicians term a ſyllogiſm; and, when propoſed in due form, runs thus:

> "Every creature poſſeſſed of reaſon and liberty is
> "accountable for his actions.
> "Man is a creature poſſeſſed of reaſon and liberty:
> "Therefore man is accountable for his actions."

63
Premiſes, concluſion, extremes, middle term.

V. In this ſyllogiſm we may obſerve, that there are three ſeveral propoſitions expreſſing the three judgements implied in the act of reaſoning; and ſo diſpoſed, as to repreſent diſtinctly what paſſes within the mind in tracing the more diſtant relations of its ideas. The two firſt propoſitions anſwer the two previous judgements in reaſoning, and are called the *premiſes,* becauſe they are placed before the other. The third is termed the *concluſion,* as being gained in conſequence of what was aſſerted in the premiſes. We are alſo to remember, that

Of Reasoning.

that the terms expressing the two ideas whose relations we inquire after, as here *man* and *accountableness*, are in general called the *extremes ;* and that the intermediate idea, by means of which the relation is traced, viz. *a creature possessed of reason and liberty*, takes the name of the *middle term.* Hence it follows, that by the *premises* of a syllogism we are always to understand the two propositions where the middle term is severally compared with the *extremes;* for these constitute the previous judgements, whence the truth we are in quest of is by reasoning deduced. The *conclusion* is that other proposition, in which the *extremes* themselves are joined or separated agreeably to what appears upon the above comparison.

64 Major and minor term, major and minor proposition.

VI. The conclusion is made up of the extreme terms of the syllogism : and the extreme, which serves as the predicate of the conclusion, goes by the name of the *major term :* the other extreme, which makes the subject in the same proposition, is called the *minor term.* From this distinction of the extremes arises also a distinction between the premises, where these extremes are severally compared with the middle term. That proposition which compares the greater extreme, or the predicate of the conclusion, with the middle term, is called the *major proposition :* the other, wherein the same middle term is compared with the subject of the conclusion or lesser extreme, is called the *minor proposition.* All this is obvious from the syllogism already given, where the conclusion is, *Man is accountable for his actions.* For here the predicate *accountable for his actions* being connected with the middle term in the first of the two premises, *every creature possessed of reason and liberty is accountable for his actions*, gives what we call the *major proposition.* In the second of the premises, *man is a creature possessed of reason and liberty*, we find the lesser extreme, or subject of the conclusion, viz. *man*, connected with the same middle term, whence it is known to be the *minor proposition.* When a syllogism is proposed in due form, the major proposition is always placed first, the minor next, and the conclusion last.

65 In a single act of reasoning the premises must be intuitive truths.

VII. These things premised, we may in the general define reasoning to be an act or operation of the mind, deducing some unknown proposition from other previous ones that are evident and known. These previous propositions, in a simple act of reasoning, are only two in number ; and it is always required that they be of themselves apparent to the understanding, insomuch that we assent to and perceive the truth of them as soon as proposed. In the syllogism given above, the premises are supposed to be self-evident truths ; otherwise the conclusion could not be inferred by a single act of reasoning. If, for instance, in the major, *every creature possessed of reason and liberty is accountable for his actions*, the connexion between the subject and predicate could not be perceived by a bare attention to the ideas themselves ; it is evident that this proposition would no less require a proof than the conclusion deduced from it. In this case a new middle term must be sought for, to trace the connexion here supposed ; and this of course furnishes another syllogism, by which having established the proposition in question, we are then, and not before, at liberty to use it in any succeeding train of reasoning. And should it so happen, that in this second essay there was still some previous proposition whose truth did not appear at first sight, we must then have recourse to a third syllogism, in order to lay open that truth to the mind : because so long as the premises remain uncertain, the conclusion built upon them must be so too. When, by conducting our thoughts in this manner, we at last arrive at some syllogism where the previous propositions are intuitive truths ; the mind then rests in full security, as perceiving that the several conclusions it has passed through stand upon the immoveable foundation of self-evidence, and when traced to their source terminate in it.

66 Reasoning, in the highest exercise of it, only a concatenation of syllogisms.

VIII. We see, therefore, that in order to infer a conclusion by a single act of reasoning, the premises must be intuitive propositions. Where they are not, previous syllogisms are required ; in which case reasoning becomes a complicated act, taking in a variety of successive steps. This frequently happens in tracing the more remote relation of our ideas ; where, many middle terms being called in, the conclusion cannot be made out but in consequence of a series of syllogisms following one another in train. But although in this concatenation of propositions, those that form the premises of the last syllogism are often considerably removed from self-evidence ; yet if we trace the reasoning backwards, we shall find them the conclusions of previous syllogisms, whose premises approach nearer and nearer to intuition in proportion as we advance, and are found at last to terminate in it. And if, after having thus unravelled a demonstration, we take it the contrary way ; and observe how the mind, setting out with intuitive perceptions, couples them together to form a conclusion : how, by introducing this conclusion into another syllogism, it still advances one step farther ; and so proceeds, making every new discovery subservient to its future progress ; we shall then perceive clearly, that reasoning, in the highest sense of that faculty, is no more than an orderly combination of those simple acts which we have already so fully explained.

67 Requires intuitive certainty in every step of the progression.

IX. Thus we see, that reasoning, beginning with first principles, rises gradually from one judgement to another, and connects them in such manner, that every stage of the progression brings intuitive certainty along with it. And now at length we may clearly understand the definition given above of this distinguishing faculty of the human mind. Reason, we have said, is the ability of deducing unknown truths from principles or propositions that are already known. This evidently appears by the foregoing account, where we see that no proposition is admitted into a syllogism, to serve as one of the previous judgements on which the conclusion rests, unless it is itself a known and established truth, whose connexion with self-evident principles has been already traced.

Chap. II. *Of the several kinds of Reasoning : and first, of that by which we determine the Genera and Species of Things.*

68 Reasoning twofold.

I. All the aims of human reason may in the general be reduced to these two : 1. To rank things under those universal ideas to which they truly belong ; and, 2. To ascribe to them their several attributes and properties in consequence of that distribution.

II. One

Of Reasoning.

69 The first kind regards the genera and species of things.

II. One great aim of human reason is to determine the genera and species of things. We have seen in the First Part of this treatise, how the mind proceeds in framing general ideas *. We have also seen in the Second Part, how by means of these general ideas we come by universal propositions. Now as in these universal propositions we affirm some property of a genus or species, it is plain that we cannot apply this property to particular objects till we have first determined whether they are comprehended under that general idea of which the property is affirmed. Thus there are certain properties belonging to all *even* numbers, which nevertheless cannot be applied to any particular number, until we have first discovered it to be of the species expressed by that natural name. Hence reasoning begins with referring things to their several divisions and classes in the scale of our ideas; and as these divisions are all distinguished by particular names, we hereby learn to apply the terms expressing general conceptions to such particular objects as come under our immediate observation.

* See *Foot note*, p. 136.

70 The steps by which we arrive at conclusions of this sort.

III. Now, in order to arrive at these conclusions, by which the several objects of perception are brought under general names, two things are manifestly necessary. First, That we take a view of the idea itself denoted by that general name, and carefully attend to the distinguishing marks which serve to characterize it. Secondly, That we compare this idea with the object under consideration, observing diligently wherein they agree or differ. If the idea is found to correspond with the particular object, we then without hesitation apply the general name; but if no such correspondence intervenes, the conclusion must necessarily take a contrary turn. Let us, for instance, take the number *eight*, and consider by what steps we are led to pronounce it an *even* number. First then, we call to mind the idea signified by the expression *an even number*, viz. that it is a number divisible into two equal parts. We then compare this idea with the number *eight*, and finding them manifestly to agree, see at once the necessity of admitting the conclusion. These several judgements therefore transferred into language, and reduced to the form of a syllogism, appear thus:

"Every number that may be divided into two equal "parts is an *even* number:
"The number eight may be divided into two equal "parts;
"Therefore the number *eight* is an *even* number."

71 Those steps always followed, though in familiar cases we do not always attend to them.

IV. Here it may be observed, that where the general idea, to which particular objects are referred, is very familiar to the mind, and frequently in view; this reference, and the application of the general name, seem to be made without any apparatus of reasoning. When we see a horse in the fields, or a dog in the street, we readily apply the name of the species; habit, and a familiar acquaintance with the general idea, suggesting it instantaneously to the mind. We are not however to imagine on this account that the understanding departs from the usual rules of just thinking. A frequent repetition of acts begets a habit; and habits are attended with a certain promptness of execution, that prevents our observing the several steps and gradations by which any course of action is accomplished. But in other instances, where we judge not by precontracted habits, as when the general idea is very complex, or less familiar to the mind, we always proceed according to the form of reasoning established above. A goldsmith, for instance, who is in doubt as to any piece of metal, whether it be of the species called *gold*, first examines its properties, and then comparing them with the general idea signified by that name, if he finds a perfect correspondence, no longer hesitates under what class of metals to rank it.

72 The great importance of this branch of reasoning;

V. Nor let it be imagined that our researches here, because in appearance bounded to the imposing of general names upon particular objects, are therefore trivial and of little consequence. Some of the most considerable debates among mankind, and such too as nearly regard their lives, interest, and happiness, turn wholly upon this article. Is it not the chief employment of our several courts of judicature to determine in particular instances, what is law, justice, and equity? Of what importance is it in many cases to decide aright whether an action shall be termed *murder* or *manslaughter*? We see then that no less than the lives and fortunes of men depend often upon these decisions. The reason is plain. Actions, when once referred to a general idea, draw after them all that may be affirmed of that idea; insomuch that the determining the species of actions is all one with determining what proportion of praise or dispraise, commendation or blame, &c. ought to follow them. For as it is allowed that murder deserves death; by bringing any particular action under the head of murder, we of course decide the punishment due to it.

73 and the exact observance of it practised by mathematicians.

VI. But the great importance of this branch of reasoning, and the necessity of care and circumspection in referring particular objects to general ideas, is still farther evident from the practice of the mathematicians. Every one who has read Euclid, knows, that he frequently requires us to draw lines through certain points, and according to such and such directions. The figures thence resulting are often squares, parallelograms, or rectangles. Yet Euclid never supposes this from their bare appearance, but always demonstrates it upon the strictest principles of geometry. Nor is the method he takes in any thing different from that described above. Thus, for instance, having defined a square to be a figure bounded by four equal sides joined together at right angles; when such a figure arises in any construction previous to the demonstration of a proposition, yet he never calls it by that name until he has shown that its sides are equal, and all its angles right ones. Now this is apparently the same form of reasoning we have before exhibited in proving *eight* to be an even number.

74 Fixed and invariable ideas, with a steady application of names, renders this part of knowledge both easy and certain.

VII. Having thus explained the rules by which we are to conduct ourselves in ranking particular objects under general ideas, and shown their conformity to the practice and manner of the mathematicians: it remains only to observe, that the true way of rendering this part of knowledge both easy and certain is, by habituating ourselves to clear and determinate ideas, and keeping them steadily annexed to their respective names. For as all our aim is to apply general words aright, if these words stand for invariable ideas that are perfectly known to the mind, and can be readily distinguished upon occasion, there will be little danger of of miſtake or error in our reaſonings. Let us ſuppoſe that, by examining any object, and carrying our attention ſucceſſively from one part to another, we have acquainted ourſelves with the ſeveral particulars obſervable in it. If among theſe we find ſuch as conſtitute ſome general idea, framed and ſettled beforehand by the underſtanding, and diſtinguiſhed by a particular name, the reſemblance thus known and perceived neceſſarily determines the ſpecies of the object, and thereby gives it a right to the name by which that ſpecies is called. Thus four equal ſides, joined together at right angles, make up the notion of a *ſquare*. As this is a fixed and invariable idea, without which the general name cannot be applied; we never call any particular figure a *ſquare* until it appears to have theſe ſeveral conditions; and contrarily, wherever a figure is found with theſe conditions, it neceſſarily takes the name of a *ſquare*. The ſame will be found to hold in all our other reaſonings of this kind, where nothing can create any difficulty but the want of ſettled ideas. If, for inſtance, we have not determined within ourſelves the preciſe notion denoted by the word *manſlaughter*, it will be impoſſible for us to decide whether any particular action ought to bear that name: becauſe, however nicely we examine the action itſelf, yet, being ſtrangers to the general idea with which it is to be compared, we are utterly unable to judge of their agreement or diſagreement. But if we take care to remove this obſtacle, and diſtinctly trace the two ideas under conſideration, all difficulties vaniſh, and the reſolution becomes both eaſy and certain.

VIII. Thus we ſee of what importance it is towards the improvement and certainty of human knowledge, that we accuſtom ourſelves to clear and determinate ideas, and a ſteady application of words.

CHAP. III. *Of Reaſoning, as it regards the powers and Properties of Things, and the Relations of our general Ideas.*

75 The diſtinction of reaſoning, as it regards the ſciences, and as it concerns common life.

I. WE now come to the ſecond great end which men have in view in their reaſonings; namely, the diſcovering and aſcribing to things their ſeveral attributes and properties. And here it will be neceſſary to diſtinguiſh between reaſoning, as it regards the ſciences, and as it concerns common life. In the ſciences, our reaſon is employed chiefly about univerſal truths, it being by them alone that the bounds of human knowledge are enlarged. Hence the diviſion of things into various claſſes, called otherwiſe *genera* and *ſpecies*. For theſe univerſal ideas being ſet up as the repreſentatives of many particular things, whatever is affirmed of them may be alſo affirmed of all the individuals to which they belong. *Murder*, for inſtance, is a general idea, repreſenting a certain ſpecies of human actions. Reaſon tells us that the puniſhment due to it is *death*. Hence every particular action, coming under the notion of *murder*, has the puniſhment of *death* allotted to it. Here then we apply the general truth to ſome obvious inſtance; and this is what properly conſtitutes the reaſoning of common life. For men, in their ordinary tranſactions and intercourſe one with another, have, for the moſt part, to do only with particular objects. Our friends and relations, their characters and behaviour, the conſtitution of the ſeveral bodies that ſurround us, and the uſes to which they may be applied, are what chiefly engage our attention. In all theſe, we reaſon about particular things; and the whole reſult of our reaſoning is, the applying the general truths of the ſciences in the ordinary tranſactions of human life. When we ſee a viper, we avoid it. Wherever we have occaſion for the forcible action of water to move a body that makes conſiderable reſiſtance, we take care to convey it in ſuch a manner that it ſhall fall upon the object with impetuoſity. Now all this happens in conſequence of our familiar and ready application of theſe two general truths. *The bite of a viper is mortal. Water falling upon a body with impetuoſity, acts very forcibly towards ſetting it in motion.* In like manner, if we ſet ourſelves to conſider any particular character, in order to determine the ſhare of praiſe or diſpraiſe that belongs to it, our great concern is to aſcertain exactly the proportion of virtue and vice. The reaſon is obvious. A juſt determination, in all caſes of this kind, depends entirely upon an application of theſe general maxims of morality: *Virtuous actions deſerve praiſe; vicious actions deſerve blame.*

76 The ſteps by which we proceed in the reaſoning of common life.

II. Hence it appears that reaſoning, as it regards common life, is no more than the aſcribing the general properties of things to thoſe ſeveral objects with which we are more immediately concerned according as they are found to be of that particular diviſion or claſs to which the properties belong. The ſteps then by which we proceed are manifeſtly theſe. Firſt, We refer the object under conſideration to ſome general idea or claſs of things. We then recollect the ſeveral attributes of that general idea. And, laſtly, Aſcribe all thoſe attributes to the preſent object. Thus, in conſidering the character of *Sempronius*, if we find it to be of the kind called *virtuous*, when we at the ſame time reflect that a virtuous character is deſerving of eſteem, it naturally and obviouſly follows that Sempronius is ſo too. Theſe thoughts put into a *ſyllogiſm*, in order to exhibit the form of reaſoning here required, run thus:

"Every virtuous man is worthy of eſteem.
"*Sempronius* is a virtuous man:
"Therefore *Sempronius* is worthy of eſteem."

77 The connexion and dependence of the two grand branches of reaſoning one upon another.

III. By this *ſyllogiſm* it appears, that before we affirm any thing of a particular object, that object muſt be referred to ſome general idea. Sempronius is pronounced worthy of eſteem only in conſequence of his being a virtuous man, or coming under that general notion. Hence we ſee the neceſſary connexion of the various parts of reaſoning, and the dependence they have one upon another. The determining the genera and ſpecies of things is, as we have ſaid, one exerciſe of human reaſon; and here we find that this exerciſe is the firſt in order, and previous to the other, which conſiſts in aſcribing to them their powers, properties, and relations. But when we have taken this previous ſtep, and brought particular objects under general names; as the properties we aſcribe to them are no other than thoſe of the general idea, it is plain that, in order to a ſucceſsful progreſs in this part of knowledge, we muſt thoroughly acquaint ourſelves with the ſeveral relations and attributes of theſe our general ideas,

ideas. When this is done, the other part will be eaſy, and requires ſcarce any labour or thought, as being no more than an application of the general form of reaſoning repreſented in the foregoing ſyllogiſm. Now, as we have already ſufficiently ſhown how we are to proceed in determining the genera and ſpecies of things, which, as we have ſaid, is the previous ſtep to this ſecond branch of human knowledge; all that is farther wanting towards a due explanation of it is, to offer ſome conſiderations as to the manner of inveſtigating the general relations of our ideas. This is the higheſt exerciſe of the powers of the underſtanding, and that by means whereof we arrive at the diſcovery of univerſal truths; inſomuch that our deductions in this way conſtitute that particular ſpecies of reaſoning which we have before ſaid regards principally the ſciences.

78
Two things required to make a good reaſoner.

IV. But that we may conduct our thoughts with ſome order and method, we ſhall begin with obſerving, that the relations of our general ideas are of two kinds: either ſuch as immediately diſcover themſelves, upon comparing the ideas one with another; or ſuch as, being more remote and diſtant, require art and contrivance to bring them into view. The relations of the firſt kind furniſh us with intuitive and ſelf-evident truths: thoſe of the ſecond are traced by reaſoning, and a due application of intermediate ideas. It is of this laſt kind that we are to ſpeak here, having deſpatched what was neceſſary with regard to the other in the Second Part. As, therefore, in tracing the more diſtant relations of things, we muſt always have recourſe to intervening ideas, and are more or leſs ſucceſsful in our reſearches according to our acquaintance with theſe ideas, and ability of applying them; and it is evident, that to make a good reaſoner, two things are principally required. *Firſt*, An extenſive knowledge of thoſe intermediate ideas, by means of which things may be compared one with another. *Secondly*, The ſkill and talent of applying them happily in all particular inſtances that come under conſideration.

79
Firſt, An extenſive knowledge of intermediate ideas.

V. In order to our ſucceſsful progreſs in reaſoning, we muſt have an extenſive knowledge of thoſe intermediate ideas by means of which things may be compared one with another. For as it is not every idea that will anſwer the purpoſe of our inquiries, but ſuch only as are peculiarly related to the objects about which we reaſon, ſo as, by a compariſon with them to furniſh evident and known truths; nothing is more apparent than that the greater variety of conceptions we can call into view, the more likely we are to find ſome among them that will help us to the truths here required. And, indeed, it is found to hold in experience, that in proportion as we enlarge our views of things, and grow acquainted with a multitude of different objects, the reaſoning faculty gathers ſtrength: for, by extending our ſphere of knowledge, the mind acquires a certain force and penetration, as being accuſtomed to examine the ſeveral appearances of its ideas, and obſerve what light they caſt one upon another.

80
To excel in any one branch of learning, we muſt be in general acquainted with the whole circle of arts and ſciences.

VI. This is the reaſon why, in order to excel remarkably in any one branch of learning, it is neceſſary to have at leaſt a general acquaintance with the whole circle of arts and ſciences. The truth of it is, all the various diviſions of human knowledge are very nearly related among themſelves, and, in innumerable inſtances, ſerve to illuſtrate and ſet off each other. And although it is not to be denied that, by an obſtinate application to one branch of ſtudy, a man may make conſiderable progreſs, and acquire ſome degree of eminence in it; yet his views will be always narrow and contracted, and he will want that maſterly diſcernment which not only enables us to purſue our diſcoveries with eaſe, but alſo, in laying them open to others, to ſpread a certain brightneſs around them. But when our reaſoning regards a particular ſcience, it is farther neceſſary that we more nearly acquaint ourſelves with whatever relates to that ſcience. A general knowledge is a good preparation, and enables us to proceed with eaſe and expedition in whatever branch of learning we apply to. But then, in the minute and intricate queſtions of any ſcience, we are by no means qualified to reaſon with advantage until we have perfectly maſtered the ſcience to which they belong.

81
Secondly, The ſkill of applying intermediate ideas happily in particular inſtances.

VII. We come now to the ſecond thing required, in order to a ſucceſsful progreſs in reaſoning; namely, the ſkill and talent of applying intermediate ideas happily in all particular inſtances that come under conſideration. And here, rules and precepts are of little ſervice. Uſe and experience are the beſt inſtructors. For, whatever logicians may boaſt of being able to form perfect reaſoners by book and rule, we find by experience, that the ſtudy of their precepts does not always add any great degree of ſtrength to the underſtanding. In ſhort, it is the habit alone of reaſoning that makes a reaſoner. And therefore the true way to acquire this talent is, by being much converſant in thoſe ſciences where the art of reaſoning is allowed to reign in the greateſt perfection. Hence it was that the ancients, who ſo well underſtood the manner of forming the mind, always began with *mathematics*, as the foundation of their philoſophical ſtudies. Here the underſtanding is by degrees habituated to truth, contracts inſenſibly a certain fondneſs for it, and learns never to yield its aſſent to any propoſition but where the evidence is ſufficient to produce full conviction. For this reaſon *Plato* has called mathematical demonſtrations the *cathartics* or purgatives of the ſoul, as being the proper means to cleanſe it from error, and reſtore that natural exerciſe of its faculties in which juſt thinking conſiſts.

82
The ſtudy of mathematical demonſtrations of great avail in this reſpect.

VIII. If therefore we would form our minds to a habit of reaſoning cloſely and in train, we cannot take any more certain method than the exerciſing ourſelves in mathematical demonſtrations, ſo as to contract a kind of familiarity with them. Not that we look upon it as neceſſary that all men ſhould be deep mathematicians; but that, having got the way of reaſoning which that ſtudy neceſſarily brings the mind to, they may be able to transfer it to other parts of knowledge, as they ſhall have occaſion.

83
As alſo of ſuch authors on other ſubjects, as are diſtinguiſhed for ſtrength and juſtneſs of reaſoning.

IX. But although the ſtudy of mathematics be of all others the moſt uſeful to form the mind and give it an early reliſh of truth, yet ought not other parts of philoſophy to be neglected. For there alſo we meet with many opportunities of exerciſing the powers of the underſtanding; and the variety of ſubjects naturally

Of Reasoning. rally leads us to observe all those different turns of thinking that are peculiarly adapted to the several ideas we examine, and the truth we search after. A mind thus trained acquires a certain mastery over its own thoughts, insomuch that it can range and model them at pleasure, and call such into view as best suit its present designs. Now in this the whole art of reasoning consists; from among a great variety of different ideas to single out those that are most proper for the business in hand, and to lay them together in such order, that from plain and easy beginnings, by gentle degrees, and a continued train of evident truths, we may be insensibly led on to such discoveries, as at our first setting out appeared beyond the reach of human understanding. For this purpose, besides the study of mathematics before recommended, we ought to apply ourselves diligently to the reading of such authors as have distinguished themselves for strength of reasoning, and a just and accurate manner of thinking. For it is observable, that a mind exercised and seasoned to truth, seldom rests satisfied in a bare contemplation of the arguments offered by others; but will be frequently assaying its own strength, and pursuing its discoveries upon the plan it is most accustomed to. Thus we insensibly contract a habit of tracing truth from one stage to another, and of investigating those general relations and properties which we afterwards ascribe to particular things, according as we find them comprehended under the abstract ideas to which the properties belong.

Chap. IV. *Of the Forms of Syllogisms.*

84 The figures of syllogisms.

I. Hitherto we have contented ourselves with a general notion of syllogisms, and of the parts of which they consist. It is now time to enter a little more particularly into the subject, to examine their various forms, and lay open the rules of argumentation proper to each. In the syllogisms mentioned in the foregoing chapters, we may observe, that the *middle term* is the subject of the *major* proposition, and the predicate of the *minor*. This disposition, though the most natural and obvious, is not however necessary; it frequently happening, that the middle term is the subject in both the premises, or the predicate in both; and sometimes, directly contrary to its disposition in the foregoing chapters, the predicate in the major, and the subject in the minor. Hence the distinction of syllogisms into various kinds, called *figures* by logicians. For figure, according to their use of the word, is nothing else but the order and disposition of the middle term in any syllogism. And as this disposition is, we see, fourfold, so the figures of syllogisms thence arising are four in number. When the middle term is the subject of the major proposition, and the predicate of the minor, we have what is called the *first figure;* As,

> " No work of God is bad :
> " The natural passions and appetites of men are
> " the work of God :
> " Therefore none of them is bad."

If, on the other hand, it is the predicate of both the premises, the syllogism is said to be the *second figure:* As,

> " Whatever is bad is not the work of God :
> " All the natural passions and appetites of men
> " are the work of God :
> " Therefore the natural passions and appetites of
> " men are not bad."

Again, In the *third figure*, the middle term is the subject of the two premises: As,

> " All Africans are black :
> " All Africans are men :
> " Therefore some men are black."

And lastly, By making it the predicate of the major, and subject of the minor, we obtain syllogisms in the *fourth figure:* As,

> " The only Being who ought to be worshipped is
> " the Creator and Governor of the world :
> " The Creator and Governor of the world is
> " God :
> " Therefore God is the only Being who ought to
> " be worshipped."

85 The moods of syllogisms.

II. But, besides this fourfold distinction of syllogisms, there is also a farther subdivision of them in every figure, arising from the *quantity* and *quality*, as they are called, of the propositions. By quantity we mean the consideration of propositions, as universal or particular; by quality, as affirmative or negative.

Now as, in all the several dispositions of the middle term, the propositions of which a syllogism consists may be either universal or particular, affirmative or negative; the due determination of these, and so putting them together as the laws of argumentation require, constitute what logicians call the *moods* of syllogisms. Of these moods there is a determinate number to every figure, including all the possible ways in which propositions differing in quantity or quality can be combined, according to any disposition of the middle term, in order to arrive at a just conclusion.

The first figure has only four legitimate moods. The major proposition in this figure must be universal, and the minor affirmative; and it has this property, that it yields conclusions of all kinds, affirmative and negative, universal and particular.

The second figure has also four legitimate moods. Its major proposition must be universal, and one of the premises must be negative. It yields conclusions both universal and particular, but all negative.

The third figure has six legitimate moods. Its minor must always be affirmative; and it yields conclusions both affirmative and negative, but all particular. ——These are all the figures which were admitted by the inventor of syllogisms, and of which, so far as we know, the number of legitimate moods has been ascertained, and severally demonstrated. In *every figure* it will be found upon trial, that there are *sixty four* different moods of syllogism; and he who thinks it worth while to construct so many in the *fourth* figure, always remembering that the *middle term* in each must be the *predicate* of the *major* and the *subject* of the *minor* proposition, will easily discern what number of these moods are *legitimate*, and give true conclusions.

Besides the rules that are proper to each figure, Aristotle has given some that are common to all, by which the legitimacy of syllogisms may be tried. These

Of Reasoning.

These may be reduced to five:——1. There must be only *three terms* in a syllogism: As each term occurs in two of the propositions, it must be precisely the *same in both*; if it be *not*, the syllogism is said to have *four terms*, which makes a *vicious* syllogism. 2. The *middle term* must be taken *universally* in *one* of the premises. 3. Both premises must *not be particular* propositions, nor both *negative*. 4. The *conclusion* must be *particular*, if *either* of the *premises* be *particular*; and *negative*, if *either* of the *premises* be *negative*. 5. No term can be taken *universally* in the *conclusion*, if it be *not* taken *universally* in the *premises*.

For understanding the *second* and *fifth* of these rules, it is necessary to observe, that a term is said to be taken *universally*, not only when it is the *subject* of a *universal* proposition, but also when it is the *predicate* of a *negative* proposition. On the other hand, a term is said to be taken *particularly*, when it is either the *subject* of a *particular* or the *predicate* of an *affirmative* proposition.

86 Foundation of the other division of syllogisms.

III. The division of syllogisms according to mood and figure respects those especially which are known by the name of plain simple syllogisms; that is, which are bounded to three propositions, all simple, and where the extremes and middle term are connected, according to the rules laid down above. But as the mind is not tied down to any one precise form of reasoning, but sometimes makes use of more, sometimes of fewer premises, and often takes in compound and conditional propositions, it may not be amiss to take notice of the different forms derived from this source, and explain the rules by which the mind conducts itself in the use of them.

87 Conditional syllogisms.

IV. When in any syllogism the major is a conditional proposition, the syllogism itself is termed *conditional*. Thus:

"If there is a God, he ought to be worshipped:
"But there is a God:
"Therefore he ought to be worshipped."

In this example, the major, or first proposition, is, we see, conditional, and therefore the syllogism itself is also of the kind called by that name. And here we are to observe, that all conditional propositions are made of two distinct parts: one expressing the condition upon which the predicate agrees or disagrees with the subject, as in this now before us, *if there is a God*; the other joining or disjoining the said predicate and subject, as here, *he ought to be worshipped*. The first of these parts, or that which implies the condition, is called the *antecedent*; the second, where we join or disjoin the predicate and subject, has the name of the *consequent*.

88 Ground of illation in conditional syllogisms.

V. In all propositions of this kind, supposing them to be exact in point of form, the relation between the antecedent and consequent must ever be true and real; that is, the antecedent must always contain some certain and genuine condition, which necessarily implies the consequent; for otherwise the proposition itself will be false, and therefore ought not to be admitted into our reasonings. Hence it follows, that when any conditional proposition is assumed, if we admit the antecedent of that proposition, we must at the same time necessarily admit the consequent; but if we reject the consequent, we are in like manner bound to reject the antecedent. For as the antecedent always expresses some condition which necessarily implies the truth of the consequent; by admitting the antecedent, we allow of that condition, and therefore ought also to admit the consequent. In like manner, if it appears that the consequent ought to be rejected, the antecedent evidently must be so too: because, as was just now demonstrated, the admitting of the antecedent would necessarily imply the admission also of the consequent.

89 The two moods of conditional syllogisms.

VI. There are two ways of arguing in *hypothetical* syllogisms, which lead to a certain and unavoidable conclusion. For as the major is always a conditional proposition, consisting of an antecedent and a consequent; if the minor admits the antecedent, it is plain that the conclusion must admit the consequent. This is called arguing from the admission of the antecedent to the admission of the consequent, and constitutes that mood or species of hypothetical syllogisms which is distinguished in the schools by the name of the *modus ponens*, inasmuch as by it the whole conditional proposition, both antecedent and consequent, is established. Thus:

"If God is infinitely wise, and acts with perfect
"freedom, he does nothing but what is best:
"But God is infinitely wise, and acts with per-
"fect freedom:
"Therefore he does nothing but what is best."

Here we see the antecedent or first part of the conditional proposition is established in the minor, and the consequent or second part in the conclusion; whence the syllogism itself is an example of the *modus ponens*. But if now we on the contrary suppose that the minor reject the consequent, then it is apparent that the conclusion must also reject the antecedent. In this case we are said to argue from the removal of the consequent to the removal of the antecedent, and the particular mood or species of syllogisms thence arising is called by logicians the *modus tollens*; because in it both antecedent and consequent are rejected or taken away, as appears by the following example:

"If God were not a Being of infinite goodness,
"neither would he consult the happiness of his
"creatures:
"But God does consult the happiness of his crea-
"tures:
"Therefore he is a Being of infinite goodness.

90 They include all the legitimate ways of arguing.

VII. These two species take in the whole class of conditional syllogisms, and include all the possible ways of arguing that lead to a legitimate conclusion; because we cannot here proceed by a contrary process of reasoning, that is, from the removal of the antecedent to the removal of the consequent, or from the establishing of the consequent to the establishing of the antecedent. For although the antecedent always expresses some real condition, which, once admitted, necessarily implies the consequent, yet it does not follow that there is therefore no other condition; and if so, then, after removing the antecedent, the consequent may still hold, because of some other determination that infers it. When we say, *If a stone is exposed some time to the rays of the sun, it will contract a certain degree of heat*; the proposition is certainly true; and, admitting the antecedent, we must also admit

Of Reasoning.

admit the consequent. But as there are other ways by which a stone may gather heat, it will not follow, from the ceasing of the before-mentioned condition, that therefore the consequent cannot take place. In other words, we cannot argue: *But the stone has not been exposed to the rays of the sun; therefore neither has it any degree of heat:* Inasmuch as there are a great many other ways by which heat might have been communicated to it. And if we cannot argue from the removal of the antecedent to the removal of the consequent, no more can we from the admission of the consequent to the admission of the antecedent: because, as the consequent may flow from a great variety of different suppositions, the allowing of it does not determine the precise supposition, but only that some one of them must take place. Thus in the foregoing proposition, *If a stone is exposed some time to the rays of the sun, it will contract a certain degree of heat;* admitting the consequent, viz. *that it has contracted a certain degree of heat*, we are not therefore bound to admit the antecedent, *that it has been some time exposed to the rays of the sun:* because there are many other causes whence that heat may have proceeded. These two ways of arguing, therefore, hold not in conditional syllogisms.

91 The manner of arguing in disjunctive syllogisms.

VIII. As from the major's being a conditional proposition, we obtain the species of conditional syllogisms: so, where it is a disjunctive proposition, the syllogism to which it belongs is also called *disjunctive*, as in the following example:

> "The world is either self-existent, or the work of "some finite, or of some infinite Being:
> "But it is not self-existent, nor the work of a finite "being:
> "Therefore it is the work of an infinite Being."

Now, a disjunctive proposition is that, where of several predicates, we affirm one necessarily to belong to the subject, to the exclusion of all the rest, but leave that particular one undetermined. Hence it follows, that as soon as we determine the particular predicate, all the rest are of course to be rejected; or if we reject all the predicates but one, that one necessarily takes place. When, therefore, in a disjunctive syllogism, the several predicates are enumerated in the major; if the minor establishes any one of these predicates, the conclusion ought to remove all the rest; or if, in the minor, all the predicates but one are removed, the conclusion must necessarily establish that one. Thus, in the disjunctive syllogism given above, the major affirms one of the three predicates to belong to the earth, viz. *self-existence*, or that it is *the work of a finite*, or that it is *the work of an infinite Being*. Two of these predicates are removed in the minor, viz. *self-existence*, and *the work of a finite being*. Hence the conclusion necessarily ascribes to it the third predicate, and affirms that it is *the work of an infinite Being*. If now we give the syllogism another turn, insomuch that the minor may establish one of the predicates, by affirming the earth to be *the production of an infinite Being:* then the conclusion must remove the other two, asserting it to be neither *self-existent*, nor *the work of a finite being*. These are the forms of reasoning in these species of syllogisms, the justness of which appears at first sight: and that there can be no other, is evident from the very nature of a disjunctive proposition.

92 Imperfect or mutilated syllogisms.

IX. In the several kinds of syllogisms hitherto mentioned, we may observe that the parts are complete; that is, the three propositions of which they consist are represented in form. But it often happens, that some one of the premises is not only an evident truth, but also familiar and in the minds of all men; in which case it is usually omitted, whereby we have an imperfect syllogism, that seems to be made up of only two propositions. Should we, for instance, argue in this manner:

> "Every man is mortal:
> "Therefore every king is mortal:

the syllogism appears to be imperfect, as consisting but of two propositions. Yet it is really complete; only the minor [*every king is a man*] is omitted: and left to the reader to supply, as being a proposition so familiar and evident that it cannot escape him.

93 Enthymemes.

X. These seemingly imperfect syllogisms are called *enthymemes;* and occur very frequently in reasoning, especially where it makes a part of common conversation. Nay, there is a particular elegance in them, because, not displaying the argument in all its parts, they leave somewhat to the exercise and invention of the mind. By this means we are put upon exerting ourselves, and seem to share in the discovery of what is proposed to us. Now this is the great secret of fine writing, so to frame and put together our thoughts, as to give full play to the reader's imagination, and draw him insensibly into our very views and course of reasoning. This gives a pleasure not unlike to that which the author himself feels in composing. It besides shortens discourse, and adds a certain force and liveliness to our arguments, when the words in which they are conveyed favour the natural quickness of the mind in its operations, and a single expression is left to exhibit a whole train of thoughts.

94 Ground of reasoning in immediate consequences.

XI. But there is another species of reasoning with two propositions, which seems to be complete in itself, and where we admit the conclusion without supposing any tacit or suppressed judgement in the mind, from which it follows syllogistically. This happens between propositions, where the connexion is such, that the admission of the one necessarily and at the first sight implies the admission also of the other. For if it so falls out, that the proposition on which the other depends is self-evident, we content ourselves with barely affirming it, and infer that other by a direct conclusion. Thus, by admitting an universal proposition, we are forced also to admit of all the particular propositions comprehended under it, this being the very condition that constitutes a proposition universal. If then that universal proposition chances to be self-evident, the particular ones follow of course, without any farther train of reasoning. Whoever allows, for instance, *that things equal to one and the same thing are equal to one another*, must at the same time allow, *that two triangles, each equal to a square whose side is three inches, are also equal between themselves.* This argument therefore,

> "Things equal to one and the same thing, are equal "to one another:

"Therefore,

Of Reaſoning.

"Therefore theſe two triangles, each equal to the
"ſquare of a line of three inches, are equal be-
"tween themſelves"—

is complete in its kind, and contains all that is neceſſary towards a juſt and legitimate concluſion. For the firſt or univerſal propoſition is ſelf-evident, and therefore requires no farther proof. And as the truth of the particular is inſeparably connected with that of the univerſal, it follows from it by an obvious and unavoidable conſequence.

95 All reducible to ſyllogiſms of ſome one form or other.

XII. Now, in all caſes of this kind, where propoſitions are deduced one from another, on account of a known and evident connexion, we are ſaid to reaſon by immediate conſequence. Such a coherence of propoſitions manifeſt at firſt ſight, and forcing itſelf upon the mind, frequently occurs in reaſoning. Logicians have explained at ſome length the ſeveral ſuppoſitions upon which it takes place, and allow of all immediate conſequences that follow in conformity to them. It is however obſervable, that theſe arguments, though ſeemingly complete, becauſe the concluſion follows neceſſarily from the ſingle propoſition that goes before, may yet be conſidered as real enthymemes, whoſe major, which is a conditional propoſition, is wanting. The ſyllogiſm but juſt mentioned, when repreſented according to this view, will run as follows:

"If things equal to one and the ſame thing, are
"equal to one another; theſe two triangles, each
"equal to a ſquare whoſe ſide is three inches, are
"alſo equal between themſelves.
"But things equal to one and the ſame thing, are
"equal to one another:
"Therefore alſo theſe triangles, &c. are equal be-
"tween themſelves."

This obſervation will be found to hold in all immediate conſequences whatſoever, inſomuch, that they are in fact no more than enthymemes of hypothetical ſyllogiſms. But then it is particular to them, that the ground on which the concluſion reſts, namely its coherence with the minor, is of itſelf apparent, and ſeen immediately to flow from the rules and reaſons of logic.

96 A ſorites of plain ſimple ſyllogiſms.

XIII. The next ſpecies of reaſoning we ſhall take notice of here is what is commonly known by the name of a *ſorites*. This is a way of arguing, in which a great number of propoſitions are ſo linked together, that the predicate of one becomes continually the ſubject of the next following, until at laſt a concluſion is formed, by bringing together the ſubject of the firſt propoſition, and the predicate of the laſt. Of this kind is the following argument:

"God is omnipotent:
"An omnipotent Being can do every thing poſ-
"ſible:
"He that can do every thing poſſible, can do what-
"ever involves not a contradiction:
"Therefore God can do whatever involves not a
"contradiction."

This particular combination of propoſitions may be continued to any length we pleaſe without in the leaſt weakening the ground upon which the concluſion reſts. The reaſon is, becauſe the ſorites itſelf may be reſolved into as many ſimple ſyllogiſms as there are middle terms in it; where this is found univerſally to hold, that when ſuch a reſolution is made, and the ſyllogiſms are placed in train, the concluſion of the laſt in the ſeries is alſo the concluſion of the ſorites. This kind of argument, therefore, as it ſerves to unite ſeveral ſyllogiſms into one, muſt ſtand upon the ſame foundation with the ſyllogiſms of which it conſiſts, and is indeed, properly ſpeaking, no other than a compendious way of reaſoning ſyllogiſtically.

97 A ſorites of hypothetical ſyllogiſms.

XIV. What is here ſaid of plain ſimple propoſitions may be as well applied to thoſe that are conditional; that is, any number of them may be ſo joined together in a ſeries, that the conſequent of one ſhall become continually the antecedent of the next following; in which caſe, by eſtabliſhing the antecedent of the firſt propoſition, we eſtabliſh the conſequent of the laſt, or by removing the laſt conſequent remove alſo the firſt antecedent. This way of reaſoning is exemplified in the following argument:

"If we love any perſon, all emotions of hatred to-
"wards him ceaſe:
"If all emotions of hatred towards a perſon ceaſe,
"we cannot rejoice in his misfortunes:
"If we rejoice not in his misfortunes, we certainly
"wiſh him no injury:
"Therefore, if we love a perſon, we wiſh him no
"injury."

It is evident that this ſorites, as well as the laſt, may be reſolved into a ſeries of diſtinct ſyllogiſms, with this only difference, that here the ſyllogiſms are all conditional.

98 The ground of argumentation in a dilemma.

XV. The laſt ſpecies of ſyllogiſm we ſhall take notice of in this chapter is that commonly diſtinguiſhed by the name of a *dilemma*. A dilemma is an argument by which we endeavour to prove the abſurdity or falſehood of ſome aſſertion. In order to this, we aſſume a conditional propoſition, the antecedent of which is the aſſertion to be diſproved, and the conſequent a disjunctive propoſition, enumerating all the poſſible ſuppoſitions upon which that aſſertion can take place. If then it appears, that all theſe ſeveral ſuppoſitions ought to be rejected, it is plain, that the antecedent or aſſertion itſelf muſt be ſo too. When therefore ſuch a propoſition as that before mentioned is made the major of any ſyllogiſm; if the minor rejects all the ſuppoſitions contained in the conſequent, it follows neceſſarily, that the concluſion ought to reject the antecedent, which, as we have ſaid, is the very aſſertion to be diſproved. This particular way of arguing is that which logicians call a *dilemma;* and from the account here given of it, it appears that we may in the general define it to be a hypothetical ſyllogiſm, where the conſequent of the major is a disjunctive propoſition, which is wholly taken away or removed in the minor. Of this kind is the following:

"If God did not create the world perfect in its
"kind, it muſt either proceed from want of in-
"clination, or from want of power:
"But it could not proceed either from want of in-
"clination, or from want of power:
"Therefore, he created the world perfect in its
"kind."

Of Reasoning.

"kind." Or, which is the same thing: "It is "absurd to say that he did not create the world "perfect in its kind."

99 An universal description of it.

XVI. The nature then of a dilemma is universally this. The major is a conditional proposition, whose consequent contains all the several suppositions upon which the antecedent can take place. As therefore these suppositions are wholly removed in the minor, it is evident that the antecedent must be so too; insomuch that we here always argue from the removal of the consequent to the removal of the antecedent. That is, a dilemma is an argument in the *modus tollens* of hypothetical syllogisms, as logicians love to speak. Hence it is plain, that if the antecedent of the major is an affirmative proposition, the conclusion of the dilemma will be negative; but if it is a negative proposition, the conclusion will be affirmative.

Chap. V. *Of Induction*.

100 Reason at first employed about particulars;

I. All reasoning proceeds ultimately from first truths, either self-evident or taken for granted; and the first truths of syllogistic reasonings are *general* propositions. But except in the mathematics, and such other sciences as, being conversant about mere ideas, have no immediate relation to things without the mind, we cannot assume as truths propositions which are general. The mathematician indeed may be considered as taking his ideas from the beginning in their *general* form. Every *proposition* composed of such ideas is therefore general; and those which are theoretic are reducible to two parts or *terms*, a *predicate* and a *subject*, with a *copula* generally affirmative. If the agreement or the relation between the two terms be not immediate and self-evident, he has recourse to an *axiom*, which is a proposition still *more general*, and which supplies him with a third or *middle term*. This he compares first with the *predicate*, and then with the *subject*, or *vice versa*. These two comparisons, when drawn out in form, make two propositions, which are called the *premises*; and if they happen to be *immediate* and *self-evident*, the *conclusion*, consisting of the terms of the question proposed, is said to be demonstrated. This method of reasoning is conducted exactly in the syllogistic form explained in the preceding chapter.

II. But in sciences which treat of things external to the mind, we cannot assume as *first principles* the most general propositions, and from them infer others less and less general till we descend to particulars. The reason is obvious. Every thing in the universe, whether of mind or body, presents itself to our observation in its individual state; so that *perception* and *judgement* employed in the investigation of truth, whether *physical*, *metaphysical*, *moral*, or *historical*, have in the first place to encounter with PARTICULARS. "With these reason begins, or should begin, its operations. It observes, tries, canvasses, examines, and compares them together, and judges of them by some of those native evidences and original lights, which, as they are the first and indispensable inlets of knowledge to the mind, have been called the *primary principles of truth*." See METAPHYSICS.

101 from which, by *induction*, it ascends to generals or axioms.

III. "By such acts of observation and judgement, diligently practised and frequently repeated, on many *individuals* of the same class or of a similar nature, noting their agreements, marking their differences however minute, and rejecting all instances which, however similar in appearance, are not in effect the same, REASON, with much labour and attention, extracts some *general laws* respecting the powers, properties, qualities, actions, passions, virtues, and relations of *real things*. This is no hasty, premature, *notional* abstraction of the mind, by which images and ideas are formed that have no archetypes in nature: it is a rational, operative, experimental process, instituted and executed upon the constitution of beings, which in part compose the universe. By this process REASON advances from *particulars* to *generals*, from *less general* to *more general*, till by a series of slow progression, and by regular degrees, it arrive at the *most general* notions, called FORMS or FORMAL CAUSES (C). And by *affirming* or *denying* a genus of a species, or an accident of a substance or class of substances, through all the stages of the gradation, we form *conclusions*, which, if logically drawn, are AXIOMS (D), or general propositions ranged one above another,

(C) Qui FORMAS novit, is, quæ adhuc non facta sunt, qualia nec naturæ vicissitudines, nec experimentales industriæ unquam in actum produxissent, nec cogitationem humanam subituræ fuissent, detegit et educit. *Baconi Nov. Org.*

(D) The word axiom, ἀξίωμα, literally signifies *dignity*: Hence it is used metaphorically to denote a *general truth* or maxim, and sometimes any truth that is self-evident, which is called a *dignity* on account of its importance in a process of reasoning. The axioms of Euclid are propositions extremely general; and so are the axioms of the Newtonian philosophy. But these two kinds of axioms have very different origins. The former appear true upon a bare contemplation of our ideas; whereas the latter are the result of the most laborious induction. Lord Bacon therefore strenuously contends that they should never be taken upon conjecture, or even upon the authority of the learned; but that, as they are the general principles and grounds of all learning, they should be canvassed and examined with the most scrupulous attention, "ut axiomatum corrigatur iniquitas, quæ plerumque in exemplis vulgatis fundamentum habent:" *De Augm. Sc.* lib. ii. cap. 2. "Atque illa ipsa putativa principia ad rationes reddendas compellare decrevimus, quousque planè constant:" *Distrib. Operis.*——Dr Tatham makes a distinction between axioms *intuitive* and axioms *self-evident*. *Intuitive* axioms, according to him, pass through the first inlets of knowledge, and flash direct conviction on the minds, as external objects do on the senses, of all men. Other axioms, though not intuitive, may be properly said to be *self-evident*; because, in their formation, reason judges by single comparisons without the help of a third idea or middle term; so that they have their evidence in themselves, and though inductively framed they cannot be syllogistically proved. If this distinction be just, and we think it is, only *particular* truths can be intuitive axioms.

Of Reaſoning.

another, till they terminate in thoſe that are UNIVERSAL.

102 The proceſs of induction exemplified in phyſics.

IV. " Thus, for inſtance, *the evidence of the external ſenſes* is obviouſly the PRIMARY PRINCIPLE from which all phyſical knowledge is derived. But, whereas nature begins with *cauſes*, which, after a variety of changes, produce *effects*, the ſenſes open upon the *effects*, and from them, through the ſlow and painful road of experiment and obſervation, aſcend to *cauſes*. By *experiments* and *obſervations* ſkilfully choſen, artfully conducted, and judiciouſly applied, the philoſopher advances from one ſtage of inquiry to another in the rational inveſtigation of the *general cauſes* of phyſical truth. From different experiments and obſervations made on the ſame individual ſubject, and from the ſame experiments and obſervations made on different ſubjects of the ſame kind, by comparing and judging, he diſcovers ſome *qualities*, *cauſes*, or *phenomena*, which, after carefully diſtinguiſhing and rejecting all contradictory inſtances that occur, he finds common to *many*. Thus from many collateral compariſons and judgements formed upon *particulars*, he aſcends to *generals*; and by a repetition of the ſame induſtrious proceſs and laborious inveſtigation, he advances from *general* to *more general*, till at laſt he is enabled to form a few of the *moſt general*, with their attributes and operations, into AXIOMS or *ſecondary principles*, which are the well-founded *laws* enacted and enforced by the God of nature.—This is that juſt and philoſophic method of reaſoning which ſound logic preſcribes in this as well as in other parts of learning; by which, through the ſlow but certain road of experiment and obſervation, the mind aſcends from appearances to qualities, from effects to cauſes; and from experiments upon many particular ſubjects forms *general propoſitions* concerning the powers and properties of phyſical body.

103 Axioms, ſo eſtabliſhed, applicable to all parts of learning.

V. " AXIOMS ſo inveſtigated and eſtabliſhed are applicable to all parts of learning, and are the indiſpenſable, and indeed the wonderful expedients, by which, in every branch of knowledge, reaſon puſhes on its inquiries in the particular purſuit of truth: and the method of reaſoning by which they are formed, is that of true and legitimate INDUCTION; which is therefore by Lord Bacon, the beſt and ſoundeſt of logicians, called the *key of interpretation*.

VI. " Inſtead of taking his axioms arbitrarily out of the great families of the categories (ſee CATEGORY), and erecting them by his own ſophiſtical invention into the principles upon which his diſputation was to be employed, had the analytical genius of Ariſtotle preſented us with the laws of the true INDUCTIVE LOGIC, by which AXIOMS are philoſophically formed, and had he with his uſual ſagacity given us an example of it in a ſingle branch of ſcience; he would have brought to the temple of truth, an offering more valuable than he has done by the aggregate of all his logic and philoſophical productions.

104 Induction prior to definition,

VII. " In all ſciences, except the mathematics, it is only after the INDUCTIVE proceſs has been induſtriouſly purſued and ſucceſsfully performed, that DEFINITION may be logically and uſefully introduced, by beginning with the *genus*, paſſing through all the graduate and ſubordinate ſtages, and marking the *ſpecific difference* as it deſcends, till it arrive at the *individual*, which is the ſubject of the queſtion. And by adding an *affirmation* or *negation* of the attribute of the *genus* or the *ſpecies* or *individual*, or of a general *accident* on the particular *ſubſtance* ſo defined, making the definition a propoſition, the truth of the queſtion will be logically ſolved without any farther proceſs. So that inſtead of being the *firſt*, as employed by the logic in common uſe, *definition* may be the *laſt* act of reaſon in the ſearch of truth in general.

105 and to ſyllogiſm.

VIII. " Theſe AXIOMS or general propoſitions, thus *inductively* eſtabliſhed, become another ſpecies of PRINCIPLES, which may be properly called SECONDARY, and which lay the foundation of the ſyllogiſtic method of reaſoning. When theſe are formed, but not before, we may ſafely admit the maxim with which logicians ſet out in the exerciſe of their art, as the great hinge on which their reaſoning and diſputation turn: *From truths that are already known, to derive other which are not known.* Or, to ſtate it more comprehenſively, ſo as to apply to probable as well as to ſcientific reaſoning—*From truths which are better known, to derive others which are leſs known.* Philoſophically ſpeaking, ſyllogiſtic reaſoning is, under *general propoſitions* to reduce others which are *leſs general* or which are *particular*; for the *inferior* ones are known to be true, only as we trace their connexion with the *ſuperior*. Logically ſpeaking, it is, To predicate a *genus* of a *ſpecies* or *individual* comprehended under it, or an *accident* of the *ſubſtance* in which it is inherent.

106 Induction and ſyllogiſm totally different.

IX. " Thus INDUCTION and SYLLOGISM are the two methods of *direct reaſoning* correſponding to the two kinds of principles, *primary* and *ſecondary*, on which they are founded, and by which they are reſpectively conducted. In both methods, indeed, reaſon proceeds by *judging* and *comparing*, but the proceſs is different throughout; and though it may have the ſanction of Ariſtotle, an *inductive ſyllogiſm* is a ſoleciſm.

107 Induction the foundation of ſyllogiſm.

X. " Till general truths are aſcertained by induction, the *third* or *middle terms* by which ſyllogiſms are made are nowhere ſafely to be found. So that another poſition of the Stagyrite, *that ſyllogiſm is naturally prior in order to induction*, is equally unfounded; for *induction* does not only naturally but neceſſarily precede *ſyllogiſm*; and, except in mathematics, is in every reſpect indiſpenſable to its exiſtence; ſince, till generals are eſtabliſhed, there can be neither *definition*, *propoſition*, nor *axiom*, and of courſe no ſyllogiſm. And as induction is the firſt, ſo is it the more *eſſential* and fundamental inſtrument of reaſoning: for as ſyllogiſm cannot produce its own *principles*, it muſt have them from induction; and if the general propoſitions or ſecondary principles be imperfectly or infirmly eſtabliſhed, and much more if they be taken at hazard, upon authority, or by arbitrary aſſumption like thoſe of Ariſtotle, all the ſyllogizing in the world is a vain and uſeleſs logomachy, only inſtrumental to the multiplication of falſe learning, and to the invention and confirmation of error. The truth of ſyllogiſms depends ultimately on the truth of axioms, and the truth of axioms on the ſoundneſs of inductions (E)."—But though induction is prior

(E) This chapter is almoſt wholly taken from *Tatham's Chart and Scale of Truth*; a work which, notwithſtanding

Of Reasoning

108 Why we have treated of syllogism first.

prior in order, as well as superior in utility, to syllogism, we have thought it expedient to treat of it last; both because syllogism is an easier exercise of the reasoning faculty than induction, and because it is the method of mathematics, the first science of reason in which the student is commonly initiated.

CHAP. VI. *Of Demonstration.*

I. HAVING dispatched what seemed necessary to be said with regard to the two methods of direct reasoning, *induction* and *syllogism*; we now proceed to consider the laws of demonstration. And here it must be acknowledged, that in strict demonstration, which removes from the mind all possibility of doubt or error, the inductive method of reasoning can have no place. When the experiments and observations from which the general conclusion is drawn are numerous and extensive, the result of this mode of reasoning is moral certainty; and could the induction be made complete, it would be absolute certainty, equally convincing with mathematical demonstration. But however numerous and extensive the observations and experiments may be upon which an inductive conclusion is established, they must of necessity come short of the number and extent of nature; which, in some cases, by its immensity, will defeat all possibility of their co-extension; and in others, by its distance, lies out of the reach of their immediate application. Though truth does not appear in all other departments of learning with that bold and resistless conviction with which it presides in the mathematical science, it shines through them all, if not interrupted by prejudice or perverted by error, with a clear and useful, though inferior strength. And as it is not necessary for the general safety or convenience of a traveller, that he should always enjoy the heat and splendor of a mid-day sun, whilst he can with more ease pursue his journey under the weaker influence of a morning or an evening ray; so it is not requisite, for the various concerns and purposes of life, that men should be led by truth of the most redundant brightness. Such truth is to be had only in those sciences which are conversant about ideas and their various relations; where every thing being certainly what it appears to be, definitions and axioms arise from mere intuition. Here *syllogism* takes up the process from the beginning; and by a sublime intellectual motion advances from the simplest axioms to the most complicated speculations, and exhibits truth springing out of its first and purest elements, and spreading on all sides into a system of science. As each step in the progress is syllogistic, we shall endeavour to explain the use and application of syllogisms in this species of reasoning.

109 Of reasoning by a concatenation of syllogisms.

We have seen, that in all the different appearances they put on, we still arrive at a just and legitimate conclusion; now it often happens, that the conclusion of one syllogism becomes a previous proposition in another; by which means great numbers of them are sometimes linked together in a series, and truths are made to follow one another in train. And as in such a concatenation of syllogisms all the various ways of reasoning that are truly conclusive may be with safety introduced; hence it is plain, that in deducing any truth from its first principles, especially where it lies at a considerable distance from them, we are at liberty to combine all the several kinds of syllogisms above explained, according as they are found best to suit the end and purpose of our inquiries. When a proposition is thus, by means of syllogisms, collected from others more evident and known, it is said to be *proved;* so that we may in the general define the proof of a proposition to be a syllogism, or series of syllogisms, collecting that proposition from known and evident truths. But more particularly, if the syllogisms of which the proofs consist admit of no premises but definitions, self-evident truths, and propositions already established, then is the argument so constituted called a *demonstration;* whereby it appears that demonstrations are ultimately founded on definitions and self-evident propositions.

110 All syllogisms whatsoever reducible to the first figure.

II. All syllogisms whatsoever, whether compound, multiform, or defective, are reducible to plain simple syllogisms in some one of the four figures. But this is not all. Syllogisms of the first figure, in particular, admit of all possible conclusions: that is, any propositions whatsoever, whether an universal affirmation or universal negative, a particular affirmative or particular negative, which fourfold division embraces all their varieties; any one of these may be inferred by virtue of some syllogism in the first figure. By this means it hapens that the syllogisms of all the other figures are reducible also to syllogisms of the first figure, and may be considered as standing on the same foundation with them. We cannot here demonstrate and explain the manner of this reduction, because it would too much swell the bulk of this treatise. It is enough to take notice that the thing is universally known and allowed among logicians, to whose writings we refer such as desire farther satisfaction in this matter. This then being laid down, it is plain that any demonstration whatsoever may be considered as composed of a series of syllogisms, all in the first figure. For, since all the syllogisms that enter the demonstration are reducible to syllogisms of some one of the four figures; and since the syllogisms of all the other figures are farther reducible to syllogisms of the first figure, it is evident, that the whole demonstration may be resolved into a series of these last syllogisms. Let us now, if possible, discover the ground upon which the conclusion rests in syllogisms of the first figure; because, by so doing, we shall come at an universal principle of certainty, whence the evidence of all demonstrations in all their parts may be ultimately derived.

111 The ground of reasoning in the first figure.

III. The rules then of the first figure are briefly these. The middle term is the subject of the major proposition, and the predicate of the minor. The major is always an universal proposition and the minor always affirmative. Let us now see what effect these rules will have in reasoning. The major is an universal proposition of which the middle term is the subject,

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standing the ruggedness of its style, has so much real merit as a system of logic, that it cannot be too diligently studied by the young inquirer who wishes to travel by the straight road to the temple of Science.

Of Reasoning.

subject, and the predicate of the conclusion the predicate. Hence it appears, that in the major the predicate of the conclusion is always affirmed or denied universally of the middle term. Again, The minor is an affirmative proposition, whereof the subject of the conclusion is the subject, and the middle term the predicate. Here then the middle term is affirmed of the subject of the conclusion; that is, the subject of the conclusion is affirmed to be comprehended under, or to make a part of, the middle term. Thus then we see what is done in the premises of a syllogism of the first figure. The predicate of the conclusion is universally affirmed or denied of some idea. The subject of the conclusion is affirmed to be or to make a part of that idea. Hence it naturally and unavoidably follows, that the predicate of the conclusion ought to be affirmed or denied of the subject. To illustrate this by an example, we shall resume one of the syllogisms of the first chapter.

"Every creature possessed of reason and liberty is accountable for his actions:
"Man is a creature possessed of reason and liberty:
"Therefore man is accountable for his actions."

Here, in the first proposition, the predicate of the conclusion, *accountableness*, is affirmed of all creatures that have reason and liberty. Again, In the second proposition, *man*, the subject of the conclusion, is affirmed to be or to make a part of this class of creatures. Hence the conclusion necessarily and unavoidably follows, viz. that man is accountable for his actions; because, if reason and liberty be that which constitutes a creature accountable, and man has reason and liberty, it is plain he has that which constitutes him accountable. In like manner, where the major is a negative proposition, or denies the predicate of the conclusion universally of the middle term, as the minor always asserts the subject of the conclusion to be or make a part of that middle term, it is no less evident that the predicate of the conclusion ought in this case to be denied of the subject. So that the ground of reasoning, in all syllogisms of the first figure, is manifestly this: "Whatever may be affirmed universally of any idea, may be affirmed of every or any number of particulars comprehended under that idea." And again: "Whatever may be denied universally of any idea, may be in like manner denied of every or any number of its individuals. These two propositions are called by logicians the *dictum de omni*, and *dictum de nullo*; and are indeed the great principles of syllogistic reasoning, inasmuch as all conclusions whatsoever rest immediately upon them, or upon propositions deduced from them. But what adds greatly to their value is, that they are really self-evident truths, and such as we cannot gainsay without running into an express contradiction. To affirm, for instance, that *no man is perfect*, and yet argue that *some men are perfect*; or to say that *all men are mortal*, and yet that *some men are not mortal*, is to assert a thing to be and not to be at the same time.

112 Demonstration an infallible guide to truth and certainty.

IV. And now we may affirm, that, in all syllogisms of the first figure, if the premises are true, the conclusion must needs be true. If it be true that the predicate of the conclusion, whether affirmative or negative, agree universally to some idea; and if it be also true that the subject of the conclusion is a part of or comprehended under that idea; then it necessarily follows, that the predicate of the conclusion agrees also to the subject. For to assert the contrary, would be to run counter to some one of the two principles before established; that is, it would be to maintain an evident contradiction. And thus we are come at last to the point we have been all along endeavouring to establish; namely, that every proposition which can be demonstrated is necessarily true. For as every demonstration may be resolved into a series of syllogisms all in the first figure; and as in any one of these syllogisms, if the premises are true, the conclusion must needs be so too; it evidently follows, that if all the several premises are true, all the several conclusions are so, and consequently the conclusion also of the last syllogism, which is always the proposition to be demonstrated. Now that all the premises of a demonstration are true, will easily appear from the very nature and definition of that form of reasoning. A demonstration, as we have said, is a series of syllogisms, all whose premises are either definitions, self-evident truths, or propositions already established. Definitions are identical propositions, wherein we connect the description of an idea with the name by which we choose to have that idea called, and therefore as to their truth there can be no dispute. Self-evident propositions appear true of themselves, and leave no doubt or uncertainty in the mind. Propositions, before established, are no other than conclusions gained by one or more steps from definitions and self-evident principles, that is, from true premises, and therefore must needs be true. Whence all the previous propositions of a demonstration being, we see, manifestly true; the last conclusion, or proposition to be demonstrated, must be so too. So that demonstration not only leads to certain truth, but we have here also a clear view of the ground and foundation of that certainty. For as, in demonstrating, we may be said to do nothing more than combine a series of syllogisms together, all resting on the same bottom; it is plain that one uniform ground of certainty runs through the whole, and that the conclusions are everywhere built upon some one of the two principles before established, as the foundation of all our reasoning. These two principles are easily reduced into one, and may be expressed thus: "Whatever predicate, whether affirmative or negative, agrees universally to any idea; the same must needs agree to every or any number of individuals comprehended under that idea." And thus at length we have, according to our first design, reduced the certainty of demonstration to one simple and universal principle; which carries its own evidence along with it, and which is indeed the ultimate foundation of all syllogistic reasoning.

113 The rules of logic furnish a sufficient criterion for the distinguishing between truth and falsehood;

V. Demonstration therefore serving as an infallible guide to truth, and therefore on so sure and unalterable a basis, we may now venture to assert, that the rules of logic furnish a sufficient criterion for the distinguishing between truth and falsehood. For since every proposition that can be demonstrated is necessarily true, he is able to distinguish truth from falsehood who can with certainty judge when a proposition is truly demonstrated. Now, a demonstration is, as we have said, nothing more than a concatenation of syllogisms, all whose premises are definitions, self-evident

evident truths, or propoſitions previouſly eſtabliſhed. To judge therefore of the validity of a demonſtration, we muſt be able to diſtinguiſh whether the definitions that enter it are genuine, and truly deſcriptive of the ideas they are meant to exhibit: whether the propoſitions aſſumed without proofs as intuitive truths have really that ſelf-evidence to which they lay claim: whether the ſyllogiſms are drawn up in due form, and agreeable to the laws of argumentation: in fine, whether they are combined together in a juſt and orderly manner, ſo that no demonſtrable propoſitions ſerve anywhere as premiſes unleſs they are concluſions of previous ſyllogiſms. Now, it is the buſineſs of logic, in explaining the ſeveral operations of the mind, fully to inſtruct us in all theſe points. It teaches the nature and end of definitions, and lays down the rules by which they ought to be framed. It unfolds the ſeveral ſpecies of propoſitions, and diſtinguiſhes the ſelf-evident from the demonſtrable. It delineates alſo the different forms of ſyllogiſms, and explains the laws of argumentation proper to each. In fine, it deſcribes the manner of combining ſyllogiſms, ſo as that they may form a train of reaſoning, and lead to the ſucceſſive diſcovery of truth. The precepts of logic, therefore, as they enable us to judge with certainty when a propoſition is duly demonſtrated, furniſh a ſure criterion for the diſtinguiſhing between truth and falſehood.

114 and extending to all caſes where a certain knowledge of truth is attainable.

VI. Perhaps it may be objected, that demonſtration is a thing very rare and uncommon, as being the prerogative of but a few ſciences, and therefore the criterion here given can be of no great uſe. But wherever, by the bare contemplation of our ideas, truth is diſcoverable, there alſo demonſtration may be attained. Now that is an abundantly ſufficient criterion which enables us to judge with certainty in all caſes where the knowledge of truth comes within our reach; for with diſcoveries, that lie beyond the limits of the human mind, we have, properly, no buſineſs or concernment. When a propoſition is demonſtrated, we are certain of its truth. When, on the contrary, our ideas are ſuch as have no viſible connection or repugnance, and therefore furniſh not the proper means of tracing their agreement or diſagreement, there we are ſure that ſcientifical knowledge is not attainable. But where there is ſome foundation of reaſoning, which yet amounts not to the full evidence of demonſtration, there the precepts of logic, by teaching us to determine aright of the degree of proof, and of what is ſtill wanting to render it full and complete, enable us to make a due eſtimate of the meaſures of probability, and to proportion our aſſent to the grounds on which the propoſition ſtands. And this is all we can poſſibly arrive at, or even ſo much as hope for, in the exerciſe of faculties ſo imperfect and limited as ours.

115 The diſtinction of demonſtration into direct and indirect.

VII. Before we conclude this chapter, it may not be improper to take notice of the diſtinction of demonſtration into *direct* and *indirect*. A *direct demonſtration* is, when, beginning with definitions, ſelf-evident propoſitions, or known and allowed truths, we form a train of ſyllogiſms, and combine them in an orderly manner, continuing the ſeries through a variety of ſucceſſive ſteps, until at laſt we arrive at a ſyllogiſm whoſe concluſion is the propoſition to be demonſtrated. Proofs of this kind leave no doubt or uncertainty behind them; becauſe, all the ſeveral premiſes being true, the concluſions muſt be ſo too, and of courſe the very laſt concluſion or propoſition to be proved. The other ſpecies of demonſtration is the *indirect*, or, as it is ſometimes called, the *apogogical*. The manner of proceeding here is, by aſſuming a propoſition which directly contradicts that we mean to demonſtrate; and thence, by a continued train of reaſoning, in the way of a direct demonſtration, deducing ſome abſurdity or manifeſt untruth. For hereupon we conclude, that the propoſition aſſumed was falſe; and thence again, by an immediate conſequence, that the propoſition to be demonſtrated is true. Thus Euclid, in his third book, being to demonſtrate *that circles which touch one another inwardly have not the ſame centre*, aſſumes the direct contrary to this, viz. *that they have the ſame centre;* and thence, by an evident train of reaſoning, proves *that a part is equal to the whole.* The ſuppoſition therefore leading to this abſurdity he concludes to be falſe, viz. *that circles touching one another inwardly have the ſame centre;* and thence again immediately infers, *that they have not the ſame centre.*

116 Ground of reaſoning in indirect demonſtrations.

VIII. Now, becauſe this manner of demonſtration is accounted by ſome not altogether ſo clear and ſatisfactory; we ſhall therefore endeavour to ſhow, that it equally with the other leads to truth and certainty. Two propoſitions are ſaid to be *contradictory* one of another, when that which is aſſerted to be in the one is aſſerted not to be in the other. Thus the propoſitions, *Circles that touch one another inwardly have the ſame centre*, and *Circles that touch one another inwardly have not the ſame centre*, are *contradictories*, becauſe the ſecond aſſerts the direct contrary of what is aſſerted in the firſt. Now, in all contradictory propoſitions, this holds univerſally, That one of them is neceſſarily true, and the other neceſſarily falſe. For if it be true, that circles which touch one another inwardly have not the ſame centre; it is unavoidably falſe that they have the ſame centre. On the other hand, if it be falſe that they have the ſame centre, it is neceſſarily true that they have not the ſame centre. Since therefore it is impoſſible for them to be both true or both falſe at the ſame time; it unavoidably follows, that one is neceſſarily true, and the other neceſſarily falſe. This then being allowed, which is indeed ſelf-evident; if any two contradictory propoſitions are aſſumed, and one of them can by a clear train of reaſoning be demonſtrated to be falſe, it neceſſarily follows that the other is true. For as the one is neceſſarily true, and the other neceſſarily falſe; when we come to diſcover which is the falſe propoſition, we thereby alſo know the other to be true.

147 Indirect demonſtrations a ſure guide to certainty.

IX. Now this is preciſely the manner of an indirect demonſtration, as is evident from the account given of it above. For there we aſſume a propoſition which directly contradicts that we mean to demonſtrate; and, having by a continued ſeries of proofs ſhown it to be falſe, thence infer that it is contradictory, or the propoſition to be demonſtrated, is true. As, therefore, this laſt concluſion is certain and unavoidable; let us next inquire after what manner we come to be ſatisfied of the falſehood of the aſſumed propoſition, that ſo no poſſible doubt may remain as to the force and validity of demonſtrations of this kind. The manner then is plainly this: Beginning with the aſſumed propoſition, we, Of Method. we, by the help of definitions, self-evident truths, or propositions already established, continue a series of reasoning, in the way of a direct demonstration, until at length we arrive at some absurdity or known falsehood. Thus Euclid, in the example before mentioned, from the supposition that circles touching one another inwardly have the same centre, deduces *that a part is equal to the whole.* Since, therefore, by a due and orderly process of reasoning, we come at last to a false conclusion; it is manifest, that all the premises cannot be true: for, were all the premises true, the last conclusion must be so too, by what has been before demonstrated. Now, as to all the other premises made use of in the course of reasoning, they are manifest and known truths by supposition, as being either definitions, self-evident propositions, or truths previously established. The assumed proposition is that only as to which any doubt or uncertainty remains. That alone, therefore, can be false; and indeed, from what has been already shown, must unavoidably be so. And thus we see, that in indirect demonstrations, two contradictory propositions being laid down, one of which is demonstrated to be false, the other, which is always the proposition to be proved, must necessarily be true; so that here, as well as in the direct way of proof, we arrive at a clear and satisfactory knowledge of truth.

118 A particular case of indirect demonstrations,

X. This is universally the method of reasoning in all apogogical or direct demonstrations. But if any proposition is assumed, from which, in a direct train of reasoning, we can deduce its contradictory; the proposition so assumed is false, and the contradictory one true. For if we suppose the assumed proposition to be true, then, since all the other premises that enter the demonstration are also true, we shall have a series of reasoning consisting wholly of true premises; whence the last conclusion or contradictory of the assumed proposition must be true likewise: so that by this means we should have two contradictory propositions both true at the same time, which is manifestly impossible. The assumed proposition, therefore, whence this absurdity flows, must necessarily be false; and consequently its contradictory, which is here the proposition deduced from it, must be true. If then any proposition is proposed to be demonstrated, and we *assume* the *contradictory* of that proposition, and thence directly infer the proposition to be demonstrated; by this very means we know that the proposition so inferred is true. For, since from an assumed proposition we have deduced its contradictory, we are thereby certain that the assumed proposition is false; and if so, then its contradictory, or that deduced from it, which in this case is the same with the proposition to be demonstrated, must be true.

119 A due knowledge of the principles of logic indispensably necessary to make us proper judges of demonstration;

XI. We have a curious instance of this in the twelfth proposition of the ninth book of the Elements. Euclid there proposes to demonstrate, *that in any series of numbers, rising from unity in geometrical progression, all the prime numbers that measure the last term in the series will also measure the next after unity.* In order to this, he assumes the contradictory of the proposition to be demonstrated; namely, *that some prime number measuring the last term in the series does not measure the next after unity;* and thence, by a continued train of reasoning, proves that it actually does measure it. Hereupon he concludes the assumed proposition to be false; and that which is deduced from it, or its contradictory, which is the very proposition he proposed to demonstrate, to be true. Now that this is a just and conclusive way of reasoning, is abundantly manifest from what we have so clearly established above. Whence it appears, how necessary some knowledge of the rules of logic is, to enable us to judge of the force, justness, and validity, of demonstrations. For, though it is readily allowed, that by the mere strength of our natural faculties we can at once discern, that of two contradictory propositions, the one is necessarily true, and the other necessarily false; yet when they are so linked together in a demonstration, as that the one serves as a previous proposition whence the other is deduced, it does not so immediately appear, without some knowledge of the principles of logic, why that alone, which is collected by reasoning, ought to be embraced as true, and the other, whence it is collected, to be rejected as false.

120 and of itself sufficient to guard us against error and false reasoning.

XII. Having thus sufficiently evinced the certainty of demonstration in all its branches, and shown the rules by which we ought to proceed, in order to arrive at a just conclusion, according to the various ways of arguing made use of; it is needless to enter upon a particular consideration of those several species of false reasoning which logicians distinguish by the name of *sophisms.* He that thoroughly understands the form and structure of a good argument, will of himself readily discern every deviation from it. And although *sophisms* have been divided into many classes, which are all called by sounding names, that therefore carry in them much appearance of learning; yet are the errors themselves so very palpable and obvious, that it would be lost labour to write for a man capable of being misled by them. Here, therefore, we choose to conclude this part of logic: and shall in the next give some account of *Method*, which, though inseparable from reasoning, is nevertheless always considered by logicians as a distinct operation of the mind; because its influence is not confined to the mere exercise of the reasoning faculty, but extends in some degree to all the transactions of the understanding.

PART IV. OF METHOD.

121 The understanding sometimes employed in putting together known truths;

WE have now done with the three first operations of the mind, whose office it is to search after truth, and enlarge the bounds of human knowledge. There is yet a fourth, which regards the disposal and arrangement of our thoughts, when we endeavour so to put them together as that their mutual connexion and dependence may be clearly seen. This is what logicians call *Method*, and place always the last in order in explaining the powers of the understanding; because it necessarily supposes a previous exercise of our other faculties, and some progress made in knowledge before we can exert it in any extensive degree.

II. In-

Of Method.

122 ſometimes in the ſearch and diſcovery of ſuch as are unknown:

II. In this view, it is plain that we muſt be beforehand well acquainted with the truths we are to combine together; otherwiſe, how could we diſcern their ſeveral connexions and relations, or ſo diſpoſe of them as their mutual dependence may require? But it often happens, that the underſtanding is employed, not in the arrangement and compoſition of known truths, but in the ſearch and diſcovery of ſuch as are unknown. And here the manner of proceeding is very different. We aſſemble at once our whole ſtock of knowledge relating to any ſubject, and, after a general ſurvey of things, begin with examining them ſeparately and by parts. Hence it comes to paſs, that whereas, at our firſt ſetting out, we were acquainted only with ſome of the grand ſtrokes and outlines of truth; by thus purſuing her through her ſeveral windings and receſſes, we gradually diſcover thoſe more inward and finer touches whence ſhe derives all her ſtrength, ſymmetry, and beauty. And here it is, that when, by a narrow ſcrutiny into things, we have unravelled any part of knowledge, and traced it to its firſt and original principles, inſomuch that the whole frame and contexture of it lies open to the view of the mind; here it is, that, taking it the contrary way, and beginning with theſe principles, we can ſo adjuſt and put together the parts as the order and method of ſcience requires.

123 Illuſtrated by the ſimilitude of a watch.

III. But as theſe things are beſt underſtood when illuſtrated by examples, let us ſuppoſe any machine, for inſtance a watch, preſented to us, whoſe ſtructure and compoſition we are as yet unacquainted with, but want, if poſſible, to diſcover. The manner of proceeding, in this caſe, is, by taking the whole to pieces, and examining the parts ſeparately, one after another. When, by ſuch a ſcrutiny, we have thoroughly informed ourſelves of the frame and contexture of each, we then compare them together, in order to judge of their mutual action and influence. By this means we gradually trace out the inward make and compoſition of the whole, and come at length to diſcern how parts of ſuch a form, and ſo put together as we found in unravelling and taking them aſunder, conſtitute that particular machine called a *watch*, and contribute to all the ſeveral motions and phenomena obſervable in it. This diſcovery being made, we can take things the contrary way, and, beginning with the parts, ſo diſpoſe and connect them as their ſeveral uſes and ſtructures require, until at length we arrive at the whole itſelf, from the unravelling of which thoſe parts reſulted.

124 Ground of the analytic and ſynthetic methods.

IV. And as it is in tracing and examining the works of art; ſo is it, in a great meaſure, in unfolding any part of human knowledge: for the relations and mutual habitudes of things do not always immediately appear upon comparing them one with another. Hence we have recourſe to intermediate ideas; and, by means of them, are furniſhed with thoſe previous propoſitions that lead to the concluſion we are in queſt of. And if it ſo happens that the previous propoſitions themſelves are not ſufficiently evident, we endeavour, by new middle terms, to aſcertain their truth; ſtill tracing things backward, in a continual ſeries, until at length we arrive at ſome ſyllogiſm where the premiſes are firſt and ſelf-evident principles. This done, we become perfectly ſatisfied as to the truth of all the concluſions we have paſſed through, inaſmuch as they are now ſeen to ſtand upon the firm and immoveable foundation of our intuitive perceptions. And as we arrived at this certainty by tracing things backward to the original principles whence they flow; ſo may we at any time renew it by a direct contrary proceſs, if, beginning with theſe principles, we carry the train of our thoughts forward until they lead us, by a connected chain of proofs, to the very laſt concluſion of the ſeries.

125 Diviſion of method into analytic and ſynthetic.

V. Hence it appears, that, in diſpoſing and putting together our thoughts, either for our own uſe, that the diſcoveries we have made may at all times lie open to the review of the mind, or where we mean to communicate and unfold the diſcoveries to others, there are two ways of proceeding equally within our choice: for we may ſo propoſe the truths relating to any part of knowledge, as they preſented themſelves to the mind in the manner of inveſtigation; carrying on the ſeries of proofs, in a reverſe order, until they at laſt terminate in firſt principles: or, beginning with theſe principles, we may take the contrary way, and from them deduce, by a direct train of reaſoning, all the ſeveral propoſitions we want to eſtabliſh. This diverſity in the manner of arranging our thoughts gives riſe to the twofold diviſion of method eſtabliſhed among logicians: for method, according to their uſe of the word, is nothing elſe but the order and diſpoſition of our thoughts relating to any ſubject. When truths are ſo propoſed and put together as they were or might have been diſcovered, this is called the *analytic method*, or the *method of reſolution*; inaſmuch as it traces things backward to their ſource, and reſolves knowledge into its firſt and original principles. When, on the other hand, they are deduced from theſe principles, and connected according to their mutual dependence, inſomuch that the truths firſt in order tend always to the demonſtration of thoſe that follow; this conſtitutes what we call the *ſynthetic method* or *method of compoſition*. For here we proceed by gathering together the ſeveral ſcattered parts of knowledge, and combining them into one whole or ſyſtem, in ſuch manner that the underſtanding is enabled diſtinctly to follow truth through all her different ſtages and gradations.

126 Called otherwiſe the method of invention, and the method of ſcience.

VI. There is this farther to be taken notice of, in relation to theſe two ſpecies of method; that the firſt has alſo obtained the name of the *method of invention*, becauſe it obſerves the order in which our thoughts ſucceed one another in the invention or diſcovery of truth. The other, again, is often denominated the *method of doctrine* or *inſtruction*; inaſmuch as, in laying our thoughts before others, we generally chooſe to proceed in the ſynthetic manner, deducing them from their firſt principles. For we are to obſerve, that although there is great pleaſure in purſuing truth in the method of inveſtigation, becauſe it places us in the condition of the inventor, and ſhows the particular train and proceſs of thinking by which he arrived at his diſcoveries; yet it is not ſo well accommodated to the purpoſes of evidence and conviction. For, at our firſt ſetting out, we are commonly unable to divine where the analyſis will lead us; inſomuch that our reſearches are for ſome time little better than a mere groping in the dark. And even after light begins to break in upon us, we are ſtill obliged to many reviews, and

Of Method.

and a frequent comparison of the several steps of the investigation among themselves. Nay, when we have unravelled the whole, and reached the very foundation on which our discoveries stand, all our certainty, in regard to their truth, will be found in a great measure to arise from that connexion we are now able to discern between them and first principles, taken in the order of composition. But in the synthetic manner of disposing our thoughts, the case is quite different: for as we here begin with the intuitive truths, and advance by regular deductions from them, every step of the procedure brings evidence and conviction along with it; so that, in our progress from one part of knowledge to another, we have always a clear perception of the ground on which our assent rests. In communicating therefore our discoveries to others, this method is apparently to be chosen, as it wonderfully improves and enlightens the understanding, and leads to an immediate perception of truth.

VII. The logic which for so many ages kept possession of the schools, and was deemed the most important of the sciences, has long been condemned as a mere art of wrangling, of very little use in the pursuit of truth. Attempts have been made to restore it to credit, but without success; and of late years little or no attention whatever has been paid to *the art of reasoning* in the course of what is called a liberal education. As both extremes may be faulty, it should seem that we cannot conclude this short treatise more properly than with the following

Reflections on the Utility of Logic.

If Aristotle was not the inventor of logic, he was certainly the prince of logicians. The whole theory of syllogisms he claims as his own, and as the fruit of much time and labour; and it is universally known, that the later writers on the art have borrowed their materials almost entirely from his Organon and Porphyry's Introduction. But after men had laboured near 2000 years in search of truth by the help of syllogisms, Lord Bacon proposed the method of induction, as a more effectual engine for that purpose; and since his days the art of logic has gradually fallen into disrepute.

To this consequence many causes contributed. The art of syllogism is admirably calculated for wrangling; and by the schoolmen it was employed with too much success, to keep in countenance the absurdities of the Romish church. Under their management it produced numberless disputes, and numberless sects, who fought against each other with much animosity without gaining or losing ground; but it did nothing considerable for the benefit of human life, whilst the method of induction has improved arts and increased knowledge. It is no wonder, therefore, that the excessive admiration of Aristotle, which continued for so many ages, should end in an undue contempt: and that the high esteem of logic, as the grand engine of science, should at last make way for too unfavourable an opinion, which seems now prevalent, of its being unworthy of a place in a liberal education. Men rarely leave one extreme without running into the contrary: Those who think according to the fashion, will be as prone to go into the present extreme as their grandfathers were to go into the former; and even they who in *general* think for themselves, when they are offended at the abuse of any thing, are too apt to entertain prejudices against the *thing itself.* "In practice (says the learned Warburton *), logic is more a *trick* than a *science*, formed rather to amuse than to instruct. And in some sort we may apply to the art of syllogism what a man of wit says of rhetoric, that it only tells us how to *name* those tools which nature had before put into our hands. In the service of chicane, indeed, it is a mere juggler's knot, now fast, now loose; and the schools where this legerdemain was exercised in great perfection are full of the stories of its wonders." The authority of Warburton is great; but it may be counterbalanced by another, which, on subjects of this nature, is confessedly greater.

* *Introduction to Julian*, &c.

"Laying aside prejudice, whether fashionable or unfashionable, let us consider (says Dr Reid †) whether logic is or may be made subservient to any good purpose. Its professed end is, to teach men to think, to judge, and to reason, with precision and accuracy. No man will say this is a matter of little importance: the only thing therefore that can admit of doubt is, whether it can be taught?

† *Appendix to Lord Kames's Sketch on the Principles and Progress of Reason.*

"To resolve this doubt, it may be observed, that our rational faculty is the gift of God, given to men in very different measures: Some have a large portion, some a less; and where there is a remarkable defect of the natural power, it cannot be supplied by any culture. But this natural power, even where it is the strongest, may lie dead for want of the means of improvement. Many a savage may have been born with as good faculties as a *Newton*, a *Bacon*, or an *Aristotle;* but their talents were buried by having never been put to use, whilst those of the philosophers were cultivated to the best advantage. It may likewise be observed, that the chief mean of improving our rational power, is the vigorous exercise of it in various ways and on different subjects, by which the habit is acquired of exercising it properly. Without such exercise, and good sense over and above, a man who has studied logic all his life may be only a petulant wrangler, without true judgement or skill of reasoning in any science."

This must have been Locke's meaning, when in his Thoughts on Education, he says, "If you would have your son to reason well, let him read Chillingworth." The state of things is much altered since Locke wrote: Logic has been much improved chiefly by his writings; and yet much less stress is laid upon it, and less time consumed in its study. His counsel, therefore, was judicious and seasonable; to wit, That the improvement of our reasoning power is to be expected much more from an intimate acquaintance with the authors who reason best, than from studying voluminous systems of school logic. But if he had meant, that the study of logic was of no use, nor deserved any attention, he surely would not have taken the pains to make so considerable an addition to it, by his *Essay on the Human Understanding*, and by his *Thoughts on the Conduct of the Understanding;* nor would he have remitted his pupil to *Chillingworth*, the acutest logician as well as the best reasoner of his age."

There is no study better fitted to exercise and strengthen the reasoning powers than that of the mathematical sciences; because there is no other branch of

Of Method. of ſcience which gives ſuch ſcope to long and accurate trains of reaſoning, or in which there is ſo little room for authority or prejudice of any kind to give a falſe bias to the judgement. When a youth of moderate parts begins to ſtudy Euclid, every thing is new to him: His apprehenſion is unſteady: his judgement is feeble; and reſts partly upon the evidence of the thing, and partly upon the authority of his teacher. But every time he goes over the definitions, the axioms, the elementary propoſitions, more light breaks in upon him; and as he advances, the road of demonſtration becomes ſmooth and eaſy; he can walk in it firmly, and take wider ſteps, till at laſt he acquires the habit not only of underſtanding a demonſtration, but of diſcovering and demonſtrating mathematical truths.

It muſt indeed be confeſſed, that a man without the rules of logic may acquire a habit of reaſoning juſtly in *mathematics*, and perhaps in any other ſcience. Good ſenſe, good examples, and aſſiduous exerciſe, may bring a man to reaſon juſtly and acutely in his own profeſſion without rules. But whoever thinks, that from this conceſſion he may infer the inutility of logic, betrays by this inference a great want of that art; for he might as well infer, becauſe a man *may* go from Edinburgh to London by the way of Paris, that therefore *any other* road is uſeleſs.

There is perhaps no art which may not be acquired, in a very conſiderable degree, by example and practice, without reducing it to rules. But practice joined with rules may carry a man forward in his art farther and more quickly than practice without rules.—Every ingenious artiſt knows the utility of having his art reduced to rules, and thereby made a ſcience. By rules he is enlightened in his practice, and works with more aſſurance. They enable him ſometimes to correct his own errors, and often to detect the errors of others; and he finds them of great uſe to confirm his judgement, to juſtify what is right, and to condemn what is wrong. Now mathematics are the nobleſt *praxis* of *logic*. Through them we may perceive how the ſtated forms of ſyllogiſm are exemplified in one ſubject, namely the predicament of quantity; and by marking the force of theſe forms, as they are there applied, we may be enabled to apply them of ourſelves elſewhere. Whoever, therefore, will ſtudy mathematics with this view, will become not only by mathematics a more expert *logician*, and by logic a more rational *mathematician*, but a wiſer philoſopher, and an acuter reaſoner, in all the poſſible ſubjects either of ſcience or deliberation. But when mathematics, inſtead of being applied to this excellent purpoſe, are uſed not to exemplify logic, but to ſupply its place; no wonder if logic fall into contempt, and if mathematics, inſtead of furthering ſcience, become in fact an obſtacle. For when men, knowing nothing of that reaſoning which is *univerſal*, come to attach themſelves for years to a *ſingle ſpecies*, a ſpecies wholly involved in *lines* and *numbers*, the mind becomes incapacitated for reaſoning at large, and eſpecially in the ſearch of *moral truth*. The object of mathematics is *demonſtration;* and whatever in that ſcience is not demonſtration, is nothing, or at leaſt below the ſublime inquirer's regard. *Probability*, through its almoſt infinite degrees, from ſimple ignorance up to abſolute certainty, is the *terra incognita* of the mathematician. And yet here it is that the great *buſineſs* of the human mind is carried on in the ſearch and diſcovery of all the important truths which concern us as reaſonable beings. And here too it is that all its *vigour* is exerted: for to proportion the aſſent to the probability accompanying every varying degree of moral evidence, requires the moſt enlarged and ſovereign exerciſe of reaſon.

In reaſonings of this kind, will any man pretend that it is of no uſe to be well acquainted with the various powers of the mind by which we reaſon? Is it of no uſe to reſolve the various kinds of reaſoning into their ſimple elements; and to diſcover, as far as we are able, the rules by which theſe elements are combined in judging and in reaſoning? Is it of no uſe to mark the various fallacies in reaſoning, by which even the moſt ingenious men have been led into error? It muſt ſurely betray great want of underſtanding, to think theſe things uſeleſs or unimportant. Now theſe are the things which logicians have attempted; and which they have executed—not indeed ſo completely as to leave no room for improvement, but in ſuch a manner as to give very conſiderable aid to our reaſoning powers. That the principles they have laid down with regard to definition and diviſion, with regard to the converſion and oppoſition of propoſitions, and the general rules of reaſoning, are not without uſe, is ſufficiently apparent from the blunders committed daily by thoſe who diſdain any acquaintance with them.

Although the art of categorical ſyllogiſm is confeſſedly little fitted for the diſcovery of unknown truth, it may yet be employed to excellent purpoſes, as it is perhaps the moſt compendious method of detecting a fallacy. A man in queſt of unknown truths muſt generally proceed by the way of induction, from effects to cauſes; but he, who as a teacher is to inculcate any ſyſtem upon others, begins with one or more ſelf-evident truths, and proceeds in the way of demonſtration, to the concluſion which he wiſhes to eſtabliſh. Now every demonſtration, as has been already obſerved, may be reſolved into a ſeries of ſyllogiſms, of which the concluſion of the preceding always enters into the premiſes of that which follows: and if the firſt principles be clear and evident, and every ſyllogiſm in ſome legitimate mode and figure, the concluſion of the whole muſt infallibly be admitted. But when the demonſtration is thus broken into parts; if we find that the concluſion of one ſyllogiſm will not, without altering the meaning of the terms, enter legitimately into the premiſes of that which ſhould immediately follow; or, ſuppoſing it to make one of the premiſes of a *new* ſyllogiſm, if we find that the concluſion, reſulting from the whole ſeries *thus* obtained, is different from that of the demonſtration; we may, in either of theſe caſes, reſt aſſured that the author's reaſoning is fallacious, and leads to error; and that if it carried an appearance of conviction before it was thus reſolved into its elementary parts, it muſt have been owing to the inability of the mind to comprehend at *once* a long train of arguments. Whoever wiſhes to ſee the ſyllogiſtic art employed for this purpoſe, and to be convinced of the truth of what we have ſaid reſpecting its utility, may conſult the excellent writer recommended by Locke, who, in places innumerable of his incomparable book, has, without pedantry, even in that pedantic age, made the happieſt application of the rules

of

Of Method. of logic for unravelling the sophistry of his Jesuitical antagonist.

Upon the whole, then, though we readily acknowledge that much time was wasted by our forefathers in syllogistic wrangling, and what might with little impropriety be termed the *mechanical* part of logic; yet the art of forming and examining arguments is certainly an attainment not unworthy the ambition of that being whose highest honour is to be endued with reason.

Logistæ, Logography.

LOGISTÆ, certain officers at Athen, in number ten, whose business consisted in receiving and passing the accounts of magistrates when they went out of office. The *logistæ* were elected by lot, and had ten *euthyni* or auditors of accounts under them.

LOGOGRAPHY, a new method of printing, in which the types, instead of answering only to single letters, are made to correspond to whole words.

This method, though seemingly a retrograde procession in the printing art, has lately obtained the sanction of his majesty's patent, and has for some time been actually put in execution in the way of trade, apparently with advantage to the proprietors. In the year 1783, a treatise upon this subject appeared by Henry Johnson, in which the origin as well as the utility of the art are fully laid down, and the matter set forth in such a light as can scarce allow us to doubt that it is an improvement in the art. Mr Johnson informs us, that about five years before, viz. in the year 1778, intending to publish a daily list of blanks and prizes in the lottery numerically arranged, he found it could not be accomplished in time by the ordinary way of printing. On this account he procured types of two, three, or more figures as was necessary for his purpose; and thus any entire number might as readily be taken up as if it had been a single type. His next attempt was in forming some large mercantile tables of pounds, shillings, pence, and farthings. For these he procured types expressive of any sum of money ready composed and united, "by which (says he) every species of figure-printing could be performed for the tenth part of the cost, printers always charging it double the price of letter-printing." Having thus succeeded to his wish in his two first attempts, he next began to consider if the method could not be applied to words; and in this also the success was equal.

The properties of the logographic art, according to our author, are, 1. That the compositor shall have less charged upon his memory than in the common way. 2. It is much less liable to error. 3. The type of each word is as easily laid hold of as that of a single letter. 4. The decomposition is much more readily performed, even by the merest novices, than they now decompose letters. 5. No extraordinary expence nor greater number of types is required in the logographic than in the common method of printing.

The first of these positions is proved by our author in the following manner. In the common method, the compositor has 150 divisions to which there is no reference, and the printing offices are not agreed with respect to the mode of placing their boxes; "but under this improvement he has only to know the letters of the alphabet, and is assisted with an index of them, insomuch that the simplicity of the latter apparatus enables him, by a little practice, to lay his finger almost blindfold on the word required; and the meanest capacity is equal to this mental exercise, having little more to do than knowing by inspection the difference between words under three and those above three syllables; and all the apparatus being within a compass not a great deal more extended than common printing, for these reasons he is as soon possessed of his type of a word as they are of a single letter."

Thus the first and third positions may be said to be proved; but in his proof of the second, our author himself shows that his art is not infallible, by substituting the word *third* instead of *second*. Substitutions of this kind, he owns, may readily take place; but such errors are much more conspicuous than literal ones, though they may be corrected with equal ease; "for the erroneous substitution cannot fail of being nearly equal in length to the word required; although, even otherwise, it would not be attended with greater disadvantage than in the common way, and it would be rectified with greater facility."

The ease with which the composition is performed, shows that there must be an equal ease in performing the decomposition; "from whence (says Mr Johnson) it is further demonstrable, that any work can be composed by this method nearly as soon as it can be deliberately read; and as to the fifth position, that it shall not require a greater expence of types, it is answered, that it is impossible for more types of letters to be wanted for this method than by any other printer according to the equal quantity of business to be performed, every office having certain known quantities of each letter called a *fount*. A printer's fount contains about 92,500 letters, and our want is not more; nay, nearer the truth, the present quantity for a fount containing much more of some letters than necessary, and fewer of others; which arises from the calculation of the quantity of each letter wanted being adhered to since the old spelling."

Our author now proceeds to demonstrate that the number of types must necessarily decrease as they are combined in syllables, and much more when formed into words. The whole art of arranging the words consists in placing them under as few divisions as possible, and still fewer subdivisions; which is attained by the following process.

1. A collection of words, with the addition of tenses, plurals, and degrees of comparison, amounting to more than 100,000, was made from the best English dictionaries:

2. Collections were made from the miscellaneous part

of 20 newſpapers, the Spectator, and Common Prayer-book. The method was, by procuring duplicates of every ſheet, ſo that each alternate ſide might be paſted over with white paper, in order to leave the whole of the words on both ſides perfect; and thus the whole might be touched with leſs danger of injury than otherwiſe could have been done. The confuſion ariſing from the parts of other words being ſeen from the oppoſite ſide was likewiſe prevented.

3. The words, being ſeparately cut out, were then put into a caſe marked with the diviſions from one to 16, according to the number of letters contained in each word. Thus ſeveral letters were diſtinctly collected; and then each ſeparate parcel ſorted in a caſe containing 26 diviſions, marked with the letters of the alphabet, according to the commencing letter of the word; and thus all the words were ranged alphabetically, conſiſting of two, three, four, or five letters, in ſeparate parcels.

4. The ſame words were then placed together, and poſted into an alphabet, with the number of times marked to each that had occurred on the whole; that in this manner a proportion might be determined how many times particular words ought to be repeated for the printing of one ſheet, and alſo to know what words are in general uſe: There are likewiſe a number of technical terms, and favourite phraſes, a great number of times repeated almoſt by every author; but though theſe occur throughout the whole book in great proportion to the reſt, no more of them will be neceſſary than what ſuffice for a ſingle ſheet.

5. The whole of the above might be done without the trouble juſt mentioned, by poſting every word at once into a triformed alphabet; becauſe the ſubdiviſions of the ſecond and third commencing letter of each word for references are now obtained, and thus can eaſily be placed in its proper diviſion, and may be marked as often as it occurs, without repeating the ſame word; whence we plainly ſee the eaſe and expedition of it, from the facility and expedition of poſting every word from a leaf in any book. Before ſuch ſubdiviſions were known, they could only have been placed under the firſt commencing letter of the word; which would cauſe ſuch a multiplicity of repetitions, that it would take up more time, be far more liable to error, and require more ſubordinate poſtings to bring them into arrangement; ſo that they may be found more eaſily than by the above proceedings. Thus alſo a collection will be obtained of ſingle and double words, which are conſtantly required from 20 to 400 or 500 times in the printing one ſheet of any work whatever; and which alone would abridge the compoſitor's work near one-third. This ſecond proceſs likewiſe enabled the author to reject, out of the firſt collection, obſolete words, technical terms, &c. which reduces the original collection to one-fifth part.

6. By proceeding in this manner, ſeveral ſpecies of words are omitted in the founts. 1. Obſolete words; becauſe they occur ſo ſeldom, that the difference of time loſt in compoſing them in the ordinary method would be imperceptible. 2. Technical terms, names of places, animals, &c.; though, for any particular work, the terms peculiar to it may be added to the fount in a biformed alphabet apart. 3. Real compounds, or words that may be compounded of others, are alſo rejected; becauſe we actually have the words already, and they may be joined with ſufficient expedition, though the ſpaces are annexed to each, by being conſtructed accordingly. 4. Thoſe of the ſame ſpelling are likewiſe omitted, though they bear different ſignifications, for obvious reaſons.

7. The variation of tenſes, degrees of compariſon, and numerous words in the Engliſh language, having in general, the ſame terminations, ſuch as ED, ING, LY, MENT, NESS, &c. an alphabet may be formed of ſuch a kind as is capable of being annexed to the abſolute words or radices, as expeditiouſly as the whole word could be ſound in the fount, from its being thereby ſo much leſs extended. Thus, by dividing ſeveral words into their radices and terminations, many other words may be formed from their radix by the addition of various terminations, and each termination may be added to other radices to which they are applicable.

8. Some radices are imperfect, viz. ſuch as end with the vowel *e*, which muſt therefore be added in the uſual way of compoſition. Thus, in the word *adore*, the radix is *ador*, to which the terminations *es*, *ed*, *eſt*, *eth*, *er*, *ing*, may be added occaſionally.

9. By rejecting alſo the words which come under this laſt denomination, the number neceſſary for a fount is reduced to one-tenth of what it would otherwiſe be, as will appear evident from the following conſiderations: 1. There are at leaſt 42 verbs, the infinitive of which ends in *ify*; as *qualify*, *ſignify*; the radices of which are *qual*, *ſign*; the terminations are, *ifies*, *ified*, *ifying*, &c. And Mr Johnſon informs us, that by applying theſe radices to other terminations, he was enabled to diſpenſe with more than 500 words which would otherwiſe have been neceſſary. 2. For all regular verbs, no more than ſix terminations are neceſſary, viz. *s*, *eſt*, *eth*, *ed*, *es*, *ing*. There are but few irregular ones in the Engliſh language; whence it happens that 12 or 14 words may be formed from one ſingle perfect verb as a radix, and many imperfect ones ſave double that number.

10. By uſing only the ſet of terminations which may be contained in a box of two feet ſquare, the common operation of printing would be ſhortened nearly one half; and in order to find out thoſe which are moſt in uſe, and fitteſt to retain, our author digeſted them alphabetically, with the radices, words, or ſyllables, which make complete words annexed to them. Thus,

tain ——s ——ed ——ing ——ment	abs—apper—aſcer de—dis—con cer—cap—cur enter—main—re—fus, &c.

11. Thus it will be found, that out of more than 100,000 words of which the Engliſh language conſiſts, there will not be wanted much above 3500 for a complete fount. This will be very evident to any perſon who conſults a dictionary. He will there find, that a vaſt number of words require an explanation; whereas in any miſcellaneous work, there are none but what can be underſtood moſt readily either together or apart. Newſpapers retain more of the uncommon kind of words than any others. "The vocabulary (ſays our author) or

or alphabet as it is called, of the Chinefe, confifts of above 80,000 letters or characters; yet he is admitted a mafter of the language who knows about 4000 of them, no more being in general ufe."

The expedition with which the logographic method of printing can be accomplifhed, depends effentially on their arrangement; which, from great numbers of experiments, our author found to be beft accomplifhed in the following manner: 1. Words of one, two, or three fyllables, are alphabetically placed by themfelves, including all poffible commencing fyllables, by which the compofitor cannot fail of finding the word either in whole or in part, let it be what it will; and when the whole cannot be found at once, the remainder may eafily be found in fingle or double fyllables among the terminations. 2. All words above three fyllables have the fame alphabetical arrangement; the terminations being the fame at the bottom of each. Experience fhows, that by a very few leffons, the meaneft capacity may determine the number of fyllables, and refer to the particular cafe containing words of that number, there being confpicuous references to each; and by thus equalizing them, any perfon may poffefs himfelf very expeditioufly of what he wants. Even boys who fcarcely knew more than the letters of the alphabet, were hardly a fortnight employed in this method, when they could at the firft glance tell the number of letters contained in any word.

By this fimplicity of arrangement, any intelligent perfon, who never compofed in his life, by being placed in a room with the apparatus, could compofe and print, without other previous inftruction than defiring him to remember that the words under three fyllables, and thofe above three, are placed in feparate alphabets; and that whenever he wants a word, the firft letter is feen in capitals of two inches on the walls, the fecond in letters of one inch in right lines; and where it is neceffary to have more columns than one for fuch fecond letter, the third is given in red down the column, comprehending about 12 divifions, to contain the types of the word coming under fuch reference.

To exemplify this method as far as it can be done without actually feeing the apparatus, our author inftances the two words *Above* and *Unfortunately*. In looking for the former, the firft letter, A, is feen upon the wall as already mentioned; the fecond, B, is on the cafe under it, and down that column is OVE, oppofite to the cell containing the types of the whole word; which would be only three references inftead of five with fpaces, as in the common method. The other word, viz. *Unfortunately*, may be found by the fame references, though it contains 13 letters; but "admitting that practice will give the word as foon as a fingle letter, the average will be found eight for one."—Our author's explanation of the method in which this word might be compofed, however, feems by no means intelligible.—"For this diftinction in the cafes (fays he), the alphabet, or rather marks of firft reference in large characters on the wall, is divided into two claffes, not as vowels and confonants, but as follows, viz. A, Con, Dif, E, In, O, P, S, Un, commencing references, the fecond or fubfequent letters of the words being in a right line from left to right, and down each column is found the remainder of the reference to the words, diftinguifhing always the third letter in red. The fecond diftinction is that for all other commencing letters, the fecond letter of reference is in a column down, and the third letter in lines from left to right in red.

Thefe are the directions given by our author for forming a fount of words; the next requifite is a fount of fyllables, formed in the following method: 1. A complete fet of two letters was obtained in all their poffible combinations, amounting to 676. 2. Having next obtained the poffible combination of thefe letters, viz. 17576, by retaining only all poffible fyllables, and words of three letters, it is reduced to the 30th part, which anfwer all the purpofes of compofing with fyllables of two and three letters, for Latin, French, Englifh, and all names of perfons, places, and things, every poffible fyllable being comprehended among them. Hence it forms an univerfal triformed alphabet, where Englifh characters are ufed; from whence all partial biformed and triformed alphabets in the arrangement of Englifh, French, Latin, and all technical matters, are drawn. Though combinations of four letters are again 26 times the number of thofe of three letters, and five letters increafe in the fame ratio; yet as much as all poffible combinations increafe in quantity proportionate to the number of letters combined, fo they decreafe in the actual number of fyllables included among them, infomuch, that all the fyllables of four, five, fix, and feven letters together, are confiderably fewer than the fyllables of three letters only.—Befides the two founts already mentioned, a third was found neceffary for fuch terminations as are moft commonly followed by particular punctuations; but, after fome confideration, this was judged unneceffary.

Our author now proceeds to obviate fome objections which muft naturally occur to one who firft hears of his invention. Thefe are,

1. A fingle letter damaged in a word renders the whole ufelefs.

This is not denied by Mr Johnfon; but he contends, that the quantity of metal loft in this manner is quite trifling.

2. How are the blanks or fpaces in a line to be managed, as thefe are by no means equal?

To this our author replies, that, at the time of writing the pamphlet, he was undetermined whether it be moft eligible to have fpaces caft along with the beginnings of words, or to fpace them in the common manner. The former would be more expeditious; and where a greater diftance is required, other fpaces may be introduced in the ordinary method.

3. How is a long word at the end of a line to be divided?

This may be eafily accomplifhed by means of the fyllabic fount already mentioned.

4. How is the error of fubftituting one word for another to be rectified?

The anfwer to this is, that an error of the kind fpecified may be corrected in the very fame manner as is done in common printing. Long words may be divided by means of the fyllabic fount already mentioned, and the intervals between the words may be filled up with *fpaces* as ufual.

LOGWOOD. See HÆMATOXYLON, BOTANY and DYEING *Index*.

LOHOCH, or LOCH, in *Pharmacy*, a compofition of of a middle consistence between a soft electuary and a syrup, principally used in disorders of the lungs.

LOINS, in *Anatomy*, the two lateral parts of the umbilical region of the abdomen.

LOIRE, the largest river in France, rises in the mountains of the Cevennes, and, after running a course of about 500 miles, falls into the bay of Biscay.

LOKE, in *Mythology*, the name of one of the deities of the northern nations, answering to the Arimanius among the Persians, whom they represent as at enmity both with gods and men, and the author of all the evils which desolate the universe. Loke is described in the Edda as producing the great serpent which encircles the world; which seems to have been intended as an emblem of corruption or sin: he also gives birth to Hela or death, the queen of the infernal regions; and also to the wolf Fenris, that monster who is to encounter the gods and destroy the world.

LOKMAN the WISE, an eminent philosopher among the Easterns. The Arabians say he was the son of Baura, the son or grandson of a sister or aunt of Job. He was an Ethiopian, and a slave for some time. It is related that he was born in the time of David, and lived till the age of the prophet Jonas. Some suppose him to have been the same with Æsop the mythologist: and indeed we find in the parables or apologues of Lokman in Arabic, many particulars that are seen in Æsop's fables; so that it is not easy to determine whether the Greek or the Arabian are the originals. He is said to have been deformed in his person; but that this defect was sufficiently made up by the perfections of his mind. Some pieces of his are extant; and he was looked upon as so excellent a person, that Mahomet has inserted a chapter of the Koran, called after his name, in which he introduces God as saying, "We heretofore bestowed wisdom on Lokman."—It is related that he got his liberty on the following occasion. His master having given him a bitter melon to eat, he ate it all. His master, surprised at his exact obedience, asked, How it was possible for him to eat such a nauseous fruit? He answered, "I have received so many favours from you, that it is no wonder I should once in my life eat a bitter melon from your hand." This generous answer of the slave struck the master to such a degree, that he immediately gave him his liberty. M. Galland translated all the fables of Lokman, and Bidpai or Pilpay, a bramin philosopher, which were published at Paris in 1724.

LOLIUM, DARNEL GRASS; a genus of plants belonging to the triandria class; and in the natural method ranking under the 4th order, *Gramina*. See BOTANY *Index*.

LOLLARDS, in ecclesiastical history, a religious sect, differing in many religious points from the church of Rome, which arose in Germany about the beginning of the 14th century; so called, as many writers have imagined, from Walter Lollard, who began to dogmatize in 1315, and was burnt at Cologn: though others think that Lollard was no surname, but merely a term of reproach applied to all heretics who concealed the poison of error under the appearance of piety.

The monk of Canterbury derives the origin of the word Lollard among us, from *lolium*, "a tare;" as if the Lollards were the tares sown in Christ's vineyard.

Abelly says, that the word Lollard signifies "praising God," from the German *loben*, "to praise," and *herr*, "Lord;" because the Lollards employed themselves in travelling about from place to place, singing psalms and hymns.

Others, much to the same purpose, derive *lollhard*, *lullhard*, or *lollert*, *lullert*, as it was written by the ancient Germans, from the old German word *lullen*, *lollen*, or *lallen*, and the termination *hard*, with which many of the High Dutch words end. *Lollen* signifies "to sing with a low voice," and therefore Lollard is a singer, or one who frequently sings; and in the vulgar tongue of the Germans it denotes a person who is continually praising God with a song, or singing hymns to his honour. The Alexians or Cellites were called *Lollards*, because they were public singers who made it their business to inter the bodies of those who died of the plague, and sang a dirge over them in a mournful and indistinct tone as they carried them to the grave. The name was afterwards assumed by persons that dishonoured it; for we find, among those Lollards who made extraordinary pretences to piety and religion, and spent the greatest part of their time in meditation, prayer, and such acts of piety, there were many abominable hypocrites, who entertained the most ridiculous opinions and concealed the most enormous vices under the specious mark of this extraordinary profession. And many injurious aspersions were propagated against those who assumed this name by the priests and monks; so that, by degrees, any person who covered heresies or crimes under the appearance of piety, was called a *Lollard*. Thus the name was not used to denote any one particular sect, but was formerly common to all persons and all sects who were supposed to be guilty of impiety towards God or the church, under an external profession of extraordinary piety. However, many societies consisting both of men and women under the name of *Lollards*, were formed in most parts of Germany and Flanders, and were supported partly by their manual labours, and partly by the charitable donations of pious persons. The magistrates and inhabitants of the towns where these brethren and sisters resided, gave them particular marks of favour and protection, on account of their great usefulness to the sick and needy. They were thus supported against their malignant rivals, and obtained many papal constitutions by which their institute was confirmed, their persons exempted from the cognizance of the inquisitors, and subjected entirely to the jurisdiction of the bishops; but as these measures were insufficient to secure them from molestation, Charles duke of Burgundy, in the year 1472, obtained a solemn bull from Pope Sixtus IV. ordering that the Cellites or Lollards should be ranked among the religious orders, and delivered from the jurisdiction of the bishops; and Pope Julius II. granted them yet greater privileges in the year 1506. Mosheim informs us that many societies of this kind are still subsisting at Cologn, and in the cities of Flanders, though they have evidently departed from their ancient rules.

Lollard and his followers rejected the sacrifice of the mass, extreme unction, and penances for sin; arguing, that Christ's sufferings were sufficient. He is likewise said to have set aside baptism, as a thing of no effect; and repentance, as not absolutely necessary, Lombard, Lombards. &c.—In England, the followers of Wickliffe were called, by way of reproach, *Lollards*, from ſome affinity there was between ſome of their tenets; though others are of opinion that the Engliſh Lollards came from Germany.

They were ſolemnly condemned by the archbiſhop of Canterbury and the council of Oxford.

LOMBARD, Peter, well known by the title of *Maſter of the Sentences*, was born at Novara in Lombardy; but being bred at Paris, he diſtinguiſhed himſelf ſo much at that univerſity, that, he firſt had the canonry of Chartres conferred on him, was ſome time tutor to Philip ſon of Louis le Gros, and laſtly obtained the ſee of Paris. He died in 1064. His work of the Sentences is looked on as the ſource of the ſcholaſtic theology of the Latin church. He wrote alſo Commentaries on the Pſalms, and on St Paul's Epiſtles.

LOMBARDS, a Scandinavian nation, who formerly ſettled in Italy, and for ſome time made a conſiderable figure.

1 Etymology of the name.

Their name of *Lombards*, or *Longobards*, is by ſome derived from the word *lack*, or *lache*, ſignifying in the German tongue *winter;* becauſe the Lombards, while in Scandinavia, lived in marſhes, or near the ſea. Others think that it comes from the two German words *langen barden*, or *helleborden*, that is, from the long halberts they were ſuppoſed to uſe in war. But Paulus Diaconus their hiſtorian, and who was himſelf a Lombard, tells us that they were called *Longobards* from the length of their beards. A nation called the *Lombards* is mentioned by Tacitus, Strabo, and Ptolemy; but theſe are different from the Lombards who afterwards ſettled in Italy, and are reckoned to be the ſame with the Gepidæ, whom the Italian Lombards almoſt exterminated. The Lombards who ſettled in Italy are firſt mentioned by Proſper Aquitanus, biſhop of Rhegium in the year 379. That writer tells us, that about this time the Lombards, abandoning the moſt diſtant coaſts of the ocean, and their native country Scandinavia, and ſeeking for new ſettlements, as they were overſtocked with people at home, firſt attacked and overcame the Vandals in Germany. They were then headed by two chiefs, Iboreus and Aion; who, dying about the year 389, were ſucceeded by Agilmund, who is commonly reckoned the firſt king of the Lombards.

2 Vandals defeated by the Lombards.

3 They ſettle in the country of the Rugians.

Before the time of Odoacer, the Lombard hiſtory affords nothing remarkable; in his time, however, they ſettled on the Danube, in the country of the Rugians, whom Odoacer had almoſt totally exterminated or carried into captivity. During their ſtay in this country, they rendered themſelves formidable to the neighbouring nations, and carried on ſucceſsful wars with the Heruli and Gepidæ. In 526, they were allowed by the emperor Juſtinian to ſettle in Pannonia; and here they made war a ſecond time with the Gepidæ. Alboinus, the Lombard king, killed the king of the Gepidæ with his own hand, put his army to the rout, and cut ſuch numbers of them in pieces, that they ceaſed from that time to be a nation. Having cauſed the deceaſed king's head to be cut off, he made a cup of his ſkull, called in the language of the Lombards *ſchala*, which he made uſe of in all public entertainments. However, having taken, among many other captives of great diſtinction, the late king's daughter, by name *Roſamunda*, he married her after the death of his former wife Clodiſvinta, the daughter of Clotaire king of France.

4 Deſtroy the Gepidæ.

By this victory Alboinus gained ſuch reputation that his friendſhip was courted by Juſtinian; and, in conſequence of the emperor's application, a body of 6000 Lombards were ſent to the aſſiſtance of Narſes againſt the Goths. The ſucceſs of the Romans in this expedition, the invaſion of Italy by the Lombards, and their ſucceſſes in that country, have been taken notice of under the article Italy, N° 28—32. At laſt Alboinus, having made himſelf maſter of Venetia, Liguria, Æmilia, Hetruria, and Umbria, was ſlain by the treachery of his wife, in the year 575, the fourth of his reign. This princeſs was the daughter of the king of the Gepidæ, whom Alboinus had killed in battle, and made a cup of his ſkull, as above related. As he was one day feaſting at Verona, with his chief favourites and principal officers, in the height of his mirth he ſent for the queen, and, filling the deteſted cup, commanded her to drink merrily with her father. Roſamund, ſtruck with horror, hurried out of the room; and highly incenſed againſt her huſband for thus barbarouſly triumphing over the misfortunes of her family, reſolved, at all events, to make him pay dear for ſuch an inhuman and affronting conduct. Accordingly, ſhe diſcovered her intention to Helmichild the king's ſhield-bearer, a youth of great boldneſs and intrepidity. Helmichild peremptorily refuſed to imbrue his hands in the blood of his ſovereign, or to be any way acceſſory to his death; and in this reſolution he perſiſted, till he was, by a ſhameful ſtratagem, forced by the queen to a compliance: for ſhe, knowing that he carried on an intrigue with one of her ladies, placed herſelf one night in her bed, and receiving the youth, indulged him as if ſhe had been his own miſtreſs in his amorous deſires; which ſhe had no ſooner done, than diſcovering herſelf to the deceived lover, ſhe told him that he muſt now either put the king to death, or be put to death by him. Helmichild, well appriſed, that, after what he had done, his ſafety depended upon the death of the king, engaged in the treaſon, which he otherwiſe abhorred. One day, therefore, while Alboinus was repoſing in his chamber after dinner, Helmichild, with ſome others whom he had made privy to his deſign, breaking in unexpectedly, fell upon the king with their daggers. Alboinus ſtarting up at their firſt coming in, laid hold of his ſword, which he had always by him; but having in vain attempted to draw it, the queen having before-hand faſtened it in the ſcabbard, he defended himſelf for ſome time with a footſtool; but was in the end overpowered, and deſpatched with many wounds.

5 Alboinus king of the Lombards aſſaſſinated at the inſtigation of his wife.

Roſamund had promiſed to Helmichild, that, as ſoon as he had deſpatched the king, ſhe would marry him, and, with her perſon, beſtow upon him the kingdom of the Lombards. The firſt part of her promiſe ſhe immediately performed; but was ſo far from being able to beſtow the crown upon him, that both of them were obliged to ſave themſelves by flight. They fled to Longinus the exarch of Ravenna, taking with them all the jewels and treaſure of the late king. Longinus received her with the greateſt marks of friendſhip and kindneſs, and aſſured her of his protection. She had not been long in Ravenna, however, before the exarch, judging

Lombards. judging that a favourable opportunity now offered of making himſelf king of Italy by her means, imparted his deſign to her, and declared his intention to marry her, provided, by ſome means or other, ſhe deſpatched Helmichild.—Roſamund, highly pleaſed with the propoſal, reſolved to ſatisfy her ambition by getting rid of the perſon whom ſhe had married in order to gratify her revenge. Accordingly, having prepared a ſtrong poiſon, ſhe mixed it with wine, and gave it to her huſband as he came out of the bath, and called for drink, according to his cuſtom. Helmichild had not half emptied the cup, when, by the ſudden and ſtrange
6 operation which he felt in his bowels, he concluded
Her death. what it was; and, with his ſword pointed at the queen's breaſt, compelled her to drink the reſt. The poiſon had the ſame effect on both; for they died in a few hours. Longinus, on the death of the queen, laid aſide all thoughts of making himſelf king of Italy, and ſent the king's treaſure to Conſtantinople, together with Albiſoinda, the daughter of Alboinus by Roſamund, whom ſhe had brought alone with her.

After the death of Alboinus, the Lombards choſe Clephis, one of the nobility, for their king. He was murdered after a ſhort reign of 18 months; upon which
7 enſued an interregnum of 10 years, as related under
Monarchy aboliſhed. the article Italy, N° 32. During this time, they extended their conqueſts in that country; but at laſt the Romans, jealous of their progreſs, reſolved to put a ſtop to their victories, and, if poſſible, to drive them quite out. For this purpoſe, they deſigned not only to employ their own force, but entered into alliance with the Franks; which ſo alarmed the Lombards that they re-eſtabliſhed the monarchical form of go-
8 vernment among themſelves, and choſe Autharis the
Reſtored. ſon of Clephis for their king. This monarch, conſidering that the power of the dukes, who had governed Lombardy for the ſpace of 10 years, was during that length of time very much eſtabliſhed, and that they would not probably be willing to part with the authority which they had ſo long enjoyed, allowed them to continue in their government; but obliged them to contribute one moiety of their revenues towards the maintenance and ſupport of his royal dignity, ſuffering them to diſpoſe of the other as they thought proper. He reſerved to himſelf the ſupreme dominion and authority; and took an oath of the dukes, that in time of war, they would readily aſſiſt him to the utmoſt of their power. Though he could remove the dukes at pleaſure, yet he deprived none of them of their dukedoms, except in caſes of treaſon; nor gave them to others, except when their male iſſue failed. Having ſettled matters in this manner with the dukes, he enacted ſeveral wholeſome laws againſt theft, rapine, murder, adultery, and other vices which prevailed among his ſubjects, and was the firſt of the Lombard kings who embraced Chriſtianity. Moſt of his ſubjects followed the example of their monarch; but as they were all inſtructed by Arian biſhops, they continued long infected with that hereſy; which occaſioned great diſputes between them and the orthodox biſhops of the
9 cities ſubject to them.

Written laws when firſt introduced. From the re-eſtabliſhment of the monarchy under Autharis, to the reign of Rotharis in 636, the hiſtory of the Lombards affords nothing memorable. This period is remarkable for the introduction of written laws among theſe people. Before his time they had Lombards. been governed only by tradition: but Rotharis, in imitation of the Romans and Goths, undertook the publiſhing of written laws; and to thoſe which he enacted, many were added by the ſucceeding princes. Grotius prefers the method which the Lombards followed in making laws, to that which was practiſed by the Romans themſelves. Among the latter the emperor was the ſole lawgiver; ſo that whatever pleaſed him had the force of a law. But the Lombard kings did not aſſume that power to themſelves, ſince their laws were enacted in public aſſemblies, convened for that purpoſe, after they had been maturely examined and approved of by all the lords of the kingdom. From theſe aſſemblies were excluded the eccleſiaſtic order, and the people: ſo that the legiſlative power was lodged in the king and nobles alone.

The reign of Rotharis is remarkable, not only for his introducing written laws among his ſubjects, but for the conqueſts he made, and the ſucceſsful wars carried on with the exarch of Ravenna, whom he totally defeated in ſeveral engagements, and made himſelf maſter of ſome part of his territories. This monarch died in 652; and the affairs of the Lombards went on proſperouſly, till the ambition of Luitprand laid the foundation of the total ruin of his kingdom. 10
He aſcended the throne of Lombardy in 711, and Luitprand's
watched all opportunities of enlarging his dominions at ambition.
the expence of the emperor's. Of this, a fair opportunity offered in 716: for the emperor Leo Iſauricus, who at that time reigned in the eaſt, having, by his famous edict, forbidden the worſhip of images, and ordered them to be everywhere pulled down, the people were ſo provoked at that innovation, that, in ſeveral places, they openly revolted, and, falling upon the emperor's officers, drove them out of the cities. In the eaſt, Germanus, patriarch of Conſtantinople, oppoſed the emperor's deſign with great warmth; but Leo cauſed him to be depoſed, and Anaſtaſius to be raiſed to that ſee in his room, ordering at the ſame time all the images in the imperial city to be pulled down and publicly burnt. He ſtrictly enjoined his officers in the weſt, eſpecially the exarch of Ravenna, to ſee his edict punctually obeyed in their reſpective governments. In compliance with theſe orders, Scholaſticus, then exarch, began to pull down the images in all the churches and public places in Ravenna; which incenſed the ſuperſtitious multitude to ſuch a degree, that taking arms, they openly declared they would rather renounce their allegiance to the emperor than the worſhip of images.

Thus a kind of civil war being kindled in the city, Luitprand thought he had now a favourable opportunity of making himſelf maſter of the ſeat of the exarch, not doubting but the conqueſt of ſuch an important place would be followed by that of the whole ex- 11
archate. Having therefore drawn together all his He beſieges
forces, he unexpectedly appeared before Ravenna, and and at laſt
cloſely beſieged it. The exarch little expected ſuch a takes Ravenna.
ſurpriſe, as a friendly correſpondence had been maintained for many years between the exarchs and the Lombard kings. However, he defended the place with ſuch courage and reſolution, that Luitprand, deſpairing of ſucceſs, broke up the ſiege and led his army againſt Claſſis, at a ſmall diſtance from Ravenna, which

2

Lombards. which he took, plundered, and levelled with the ground. The loss of this place, and the severe treatment the inhabitants met with from the king, threw the citizens of Ravenna into the utmost consternation; which Luitprand being informed of, he resolved to take advantage of their fears, and, returning before Ravenna while the inhabitants were thus disheartened, to attempt once more the reduction of that place. Accordingly he led his whole army against it, and, by frequent attacks, tired the inhabitants and garrison to such a degree, that the exarch, finding they could hold out no longer, and despairing of relief, privately withdrew. Luitprand, informed of his retreat, attacked the town with more violence than ever; and, having carried it by storm, gave it to be plundered by his soldiers, who found in it an immense booty, as it had been for a long time the seat of the Roman emperors, of the Gothic kings, and the exarchs. The king stripped it of most of its valuable monuments of antiquity, and caused, among the rest, an equestrian statue of an emperor, of wonderful workmanship, to be conveyed to Pavia, where it is to be seen to this day. The reduction of Ravenna was followed by the surrender of several cities of the exarchate, which Luitprand reduced to a dukedom; appointing Hildebrand his grandson to govern it with the title of duke: and giving him, as he was yet an infant, Peredeus duke of Vicenza for his guardian.

12 Reduces the exarchate to a dukedom.

The conquest of Ravenna and the greater part of the exarchate did not a little alarm Gregory II. bishop of Rome. He was then at variance with the emperor, whose edict against the worshipping of images he had opposed with all his might, and by that means provoked Leo to such a degree, that he had threatened to drive him from the see, and send him into exile. However, the pope, no less jealous of the power of the Lombards than all his predecessors had been, resolved, by some means or other, to put a stop to their conquests. The only prince in Italy to whom he could have recourse was Ursus duke of Venice, the Venetians making already no inconsiderable figure. To him accordingly he wrote a very pressing letter; conjuring him to assist his worthy son the exarch, and, for the love of the holy faith, to attempt with him the recovery of the exarchate, which the wicked nation of the Lombards had unjustly taken from his sons Leo and Constantine emperors. Ursus and the Venetians, moved with the pope's letter, and at the same time greatly alarmed at the growth of so powerful a neighbour, promised to assist the exarch with the whole strength of their republic; and accordingly fitted out a considerable fleet, pretending it was designed for the service of the emperor against the Saracens. At the same time the exarch, who had taken refuge in Venice, abandoning that place, as it were in despair of bringing the duke over to his party, raised, in the places still subject to the emperor, what forces he was able; and having got together a considerable body, he marched with them towards Imola, giving out that he designed to besiege that city; but turning on a sudden towards Ravenna, as had been agreed on between him and the Venetians, he laid siege to it by land, while they invested it almost at the same instant by sea. Peredeus defended the town for some time with great courage and resolution: obliging all those who were able to bear arms to repair to the walls. But the Venetians having, in spite of all opposition, forced open one of the gates on the side of the sea, the city was taken, and Peredeus slain, while he was attempting, at the head of a choice body, to drive the enemy from the posts they had seized. As for Hildebrand, he fell into the hands of the Venetians; who, having thus recovered Ravenna to the emperor, returned home, leaving the exarch in possession of the city. Luitprand was then at Pavia; but the town was taken before he could assemble his troops to relieve it.

13 The exarch assisted by the Venetians;

Lombards.

14 who retake Ravenna.

And now Gregory bishop of Rome, to whom the recovery of Ravenna was chiefly owing, persuading himself, that the emperor would, out of gratitude, give ear to his remonstrances and admonitions, began to solicit him with more pressing letters than ever to revoke his edict against the worship of images: but Leo, well apprised that the bishop, in all the measures he had taken, had been more influenced by a regard to his own interest than to that of the empire, instead of hearkening to his remonstrances, was still more provoked against him for thus obstinately opposing the execution of his edict. Being, therefore, resolved at all events to have it observed in Rome itself, and, on the other hand, not doubting but the pope would oppose it to the last with all his might; in order to remove all obstacles, he sent three officers to Rome, with private orders, either to despatch the pope, or to take him prisoner and convey him to Constantinople. At the same time, he wrote to Mauritius duke of Rome, secretly enjoining him to assist his three officers in their undertaking: but no favourable opportunity offering to put their design in execution, the emperor, in the year 725, recalled Scholasticus, and sent Paul a patrician into Italy, to govern in his room, with private instructions to encourage the above-mentioned officers with the promise of great rewards, and to assure them of his protection.

But, in the mean time, the plot was discovered, and two of the conspirators were apprehended by the citizens of Rome, and put to death; the third having escaped into a monastery, where he took the monastic habit and ended his days. Hereupon the exarch, in compliance with the emperor's orders, resolved to proceed no longer by secret plots, but by open force. Accordingly, he drew together a considerable body of troops, and set out at the head of them on his march to Rome, with a design to seize on the pope, and send him, as he had engaged to do, in chains to Constantinople. But, on this occasion, Luitprand, though highly provoked against Gregory for having stirred up the Venetians against him, yet resolved to assist him and the citizens of Rome against the exarch, in order to keep the balance even between them, and by assisting sometimes the one and sometimes the other, weaken both. Pursuant to this resolution, he ordered the Lombards of Tuscany, and those of the dukedom of Spoletto, to join the pope and the inhabitants of Rome; who, being by this reinforcement far superior in strength and number to the exarch, obliged him to return to Ravenna, and give over all thoughts of any further attempt on the person of the pope.

15 Luitprand assists the pope against the exarch.

In the mean time, Leo, persisting in his former resolution of suppressing throughout his dominions the worship of images, sent fresh orders to the exarch Paul, Lombards. Paul, strictly enjoining him to cause his edict to be put in execution in all the cities of Italy under his empire, especially in Rome. At the same time, he wrote to the pope, promising him his favour and protection if he complied with the edict; and declaring him, if he continued to oppose it, a rebel, and no longer vested with the papal dignity. But Gregory was so far from yielding to the emperor's threats, or promises, that, on the contrary, he solemnly excommunicated the exarch for attempting to put the imperial edict in execution: and at the same time wrote circular letters to the Venetians, to King Luitprand, to the Lombard dukes, and to all the chief cities of the empire, exhorting them to continue stedfast in the Catholic faith, and to oppose with all their might such a detestable innovation. These letters made such an impression on the minds of the people in Italy, that though of different interests, and often at war with one another, they all united; protesting they would defend the Catholic faith, and the life of the pope, in so glorious a cause, at the expence of their own; nay, the citizens of Rome, and the inhabitants of Pentapolis, now Marca d'Ancona, not contenting themselves with such a protestation, openly revolted from the emperor; and, pulling down his statues, they elected, by their own authority, magistrates to govern them during the interregnum. We are even told, that, transported with a blind zeal, they were for choosing a new emperor, and conducting him to Constantinople, not doubting but the people would everywhere join them. But the pope, thinking this resolution unseasonable, and not to be easily put in execution, opposed it; so that it did not take place.

In the mean time, the exarch Paul, having gained a considerable party in Ravenna, began, pursuant to the repeated orders from the emperor, to remove the images, as so many idols, out of the churches. Hereupon the adverse party, supported and encouraged by

16 A civil war in Ravenna. the pope, flew to arms; and, falling upon the *iconoclasts*, or image-breakers, as they styled them, gave rise to a civil war within the walls of Ravenna. Great numbers were killed on both sides: but those who were for the worship of images prevailing in the end, a dreadful slaughter was made of the opposite party; and, among the rest, the exarch himself was murdered. However, the city of Ravenna continued faithful to the emperor; but most of the cities of Romagna belonging to the exarchate, and all those of Pentapolis or La Marca d'Ancona, abhorring the emperor as an heretic, submitted to Luitprand king of the Lombards; who, pretending a zeal for the Catholic religion, took care to improve the discontent of the people to his advantage, by representing to them, that they could never maintain their religious rights under a prince, who was not only an heretic, but a persecutor of the orthodox.

In Naples, Exhilaratus, duke of that city, having received peremptory orders from the emperor to cause his edict to be put in execution, did all that lay in his power to persuade the people to receive it; but finding all his endeavours thwarted by the bishop of Rome, for whom the Neapolitans had a great veneration, he hired assassins to murder him. But the plot being discovered, though carried on with great secrecy, the Neapolitans, highly provoked against the duke, tore both him and his son to pieces, and likewise put to death one of his chief officers, who had composed a libel against the pope. Luitprand, and Gregory at that time duke of Benevento, laying hold of so favourable an opportunity to make themselves masters of the dukedom of Naples, did all that lay in their power to persuade the Neapolitans to submit to them. But the Neapolitans, bearing an irreconcilable hatred to the Lombards, with whom they had been constantly at variance, rejected every overture of that nature with the utmost indignation; and, continuing stedfast in their allegiance to Leo, received from Constantinople one Peter, who was sent to govern them in the room of Exhilaratus. Some writers suppose the Neapolitans, in this general revolt of the cities of Italy, to have shaken off the yoke with the rest, and to have appointed magistrates of their own election to govern them, in the room of the officers hitherto sent from Constantinople, or named by the exarch: but they are certainly mistaken; it being manifest from history, that Peter succeeded Exhilaratus in that dukedom, and that the Neapolitans continued to live under the emperors, till they were conquered many years after by the Normans.

In the mean time, Leo hearing of the murder of the exarch, and the general revolt of the cities, and not doubting but the pope was the chief author of so much mischief, sent the eunuch Eutychius into Italy, with the title and authority of *exarch*, strictly enjoining him to get the pope despatched by some means or other, since his death was absolutely necessary for the tranquillity of Italy. The exarch spared no pains to get the pope into his power: but a messenger, whom he had sent to Rome, being apprehended by the citizens, and an order from the emperor being found upon him to all his officers in that city, commanding them to put the pope to death at all events, the pope's friends thenceforth guarded him with such care, that the exarch's emissaries could never afterwards find an opportunity of executing their design. As for the messenger, the Romans were for putting him to death; but the pope interposed, contenting himself with excommunicating the exarch.

And now the Romans, provoked more than ever against Leo, and, on the other hand, unwilling to live under the Lombards, resolved to revolt from the emperor, and appoint their own magistrates, keeping themselves united under the pope, not yet as their prince, but only as their head. This they did accordingly; and from these slender beginnings the sovereignty of the popes in Italy took its rise, though they did not then, as is commonly supposed by historians, but many years after, become sovereign lords of Rome. 17 The Romans revolt.

Eutychius failed in his design upon the life of the pope; but having brought with him from Constantinople a good number of troops, he easily quelled the rebellion in Ravenna, and severely punished the authors of the late disturbances. As for the rebellious Romans, he was well apprised he could never reduce them, so long as they were supported by the king of the Lombards; and therefore he employed all his art and policy to take off that prince from the party of the Romans, and bring him over to his own.

Luitprand, for some time, withstood all his offers; but

Lombards. but Thrasimund duke of Spoletto revolting at this very juncture, the exarch, laying hold of that opportunity, offered to assist the king with all his strength against the rebellious duke, provided he would, in like manner, assist him against the pope and the Romans. With this proposal Luitprand readily closed; and a league being concluded upon these terms between him and the exarch, the two armies joined, and began their march towards Spoletto. At their approach, the duke, despairing of being able to resist two such powers, came out with a small attendance to meet them, and, throwing himself at the king's feet, sued, in that humble posture, for pardon; which Luitprand not only granted him, but confirmed him in the dukedom, after he had obliged him to take a new oath of allegiance, and give hostages for his fidelity in time to come. From Spoletto, the two armies marched, in pursuance of the treaty, to Rome; and encamped in the meadows of Nero, between the Tiber and the Vatican.

18 Luitprand concludes an alliance with the exarch.

19 The pope submits to Luitprand.

Gregory had caused the city of Rome to be fortified in the best manner he could; but being sensible that the Romans alone could not long hold out against two such armies, and reflecting on the kind treatment the duke of Spoletto had met with upon his submitting to the king, he resolved to follow his example: and accordingly, taking with him some of the clergy, and the principal inhabitants of the city, he went to wait on the king in his camp; and there, with a pathetic speech, as he was a great master of eloquence, softened Luitprand to such a degree, that, throwing himself at his feet in the presence of the whole army, he begged pardon for entering into an alliance against him: and, assuring him of his protection for the future, he went with them to the church of St Peter; and there, disarming himself in the presence of his chief officers, he laid his girdle, his sword, and his gauntlet, with his royal mantle, his crown of gold, and cross of silver, on the apostle's sepulchre. After this, he reconciled the pope with the exarch, who was thereupon received into the city, where he continued for some time, maintaining a friendly correspondence with the pope. At this time an impostor, taking the name of *Tiberius*, and pretending to be descended from the emperors, seduced a great many people in Tuscany, and was by them proclaimed emperor. The exarch, resolved to march against him; but as he had not sufficient forces to oppose the rebels, Gregory, who let no opportunity slip of obliging Leo, persuaded the Romans to attend the exarch in this expedition; by which means the usurper being taken in a castle, his head was sent to the emperor, and the rebellion utterly suppressed. But the emperor still insisting upon his edict against the images being received in Rome, the Romans, at the instigation of the pope, publicly renounced their allegiance to Leo, paid him no more tribute, and withdrew for ever their obedience to the emperors of the East.

20 The emperor seizes the dominions of the pope.

Leo, informed of this revolt, and not questioning but the pope was the author of it, immediately caused all the patrimonies of the church of Rome in Sicily, Calabria, and his other dominions, to be confiscated. At the same time, he ordered a powerful army to be raised, with a design to recover the towns that had revolted; to chastise the Romans for their rebellion; and, above all, to be revenged on the pope, who had raised all these disturbances, by himself opposing, and persuading others to oppose, the execution of his edict. Gregory, alarmed at the warlike preparations that were carrying on throughout the empire, and well apprised that they were chiefly designed against him and the Romans, resolved to recur to the protection of the French, the only nation at that time capable of coping with the emperor, and on whom, on account of their zeal for religion, he thought he might depend. The Lombards were then very powerful; but, as they wanted to be masters of Rome, he did not think it advisable to trust them. The Venetians, though zealous in the defence of the pope, were not yet in a condition to withstand the power of the emperor; and, besides, were jealous of the Lombards, who watched all opportunities of enlarging their dominions at the expence of their neighbours. As for Spain, it was then in a most deplorable condition, being overrun, and almost wholly ruined, by the Saracens.

21 Who applies to the French.

The French nation was at this time governed by the celebrated Charles Martel, who had distinguished himself in a most eminent manner in the wars of France and Germany; and had, not long before, gained a signal victory over the Saracens in the neighbourhood of Tours; whence he was generally reputed the best commander, and the greatest hero, of his time. To him, therefore, Gregory sent a solemn embassy, with a great number of relics, earnestly entreating him to take the Romans, and the church, under his protection, and defend them against the attempts of Leo. The ambassadors were received with extraordinary marks of honour; and a treaty was soon concluded between them and Charles, who engaged to march into Italy in person, at the head of a powerful army, in defence of the Romans and the church, if they should be attacked either by the emperor or the Lombards. On the other hand, the Romans were to acknowledge him for their protector, and confer on him the honour of the consulship, as it had been formerly conferred on Clovis by the emperor Anastasius, after that prince had defeated the Visigoths. The ambassadors returned from France loaded with rich presents. But Gregory did not long enjoy the fruit of their negociations; for he died the same year 731, and was succeeded by Gregory III. in whose time some place the above-mentioned embassy.

22 End of the Lombard monarchy.

The French nation was at this time just recovered from its distressed situation under the descendants of Clovis; and by the bravery and conduct of Charles Martel, had become the most powerful kingdom in the west. His successor Pepin was no less wise and powerful than his father had been; and as the ambition of the Lombard princes would be satisfied with nothing less than the entire conquest of Italy, the French monarch, Charlemagne, under colour of assisting the pope, at last put an end to the empire of Lombardy, as related under the article FRANCE, N° 21, 22.

23 Character, &c. of the Lombards.

The Lombards were at first a cruel and barbarous nation; but divesting themselves by degrees of their native fierceness and barbarity, especially after they had embraced the Christian religion, they governed with such equity and moderation, that most other nations

tions envied the happiness of those who lived under them. Under the government of the Lombards (says Paulus Diaconus) no violence was committed, no one unjustly dispossessed of his property, none oppressed with taxes; theft, robberies, murder, and adultery, were seldom heard of: every one went, without the least apprehension, wherever he pleased. Their laws were so just and equitable, that they were retained in Italy, and observed there some ages after their kingdom was at an end.—According to Paulus Diaconus, also, their dress was loose, and for the most part of linen, such as the Anglo-Saxons wore, being interwoven with various colours; that their shoes were open to the end of their foot, and that they used to button or lace them. From some ancient paintings, it appears, that they shaved the back part of their heads, but that their hair was long before; their locks being parted, and laid on each side their foreheads.

LOMBART, or LOMBARD, PETER, an engraver of considerable eminence, who flourished about the year 1660. He was a native of Paris, where he learned the art of engraving. It appears that he came to England before the revolution, because some of his plates for English publications are dated prior to that event. He executed a vast variety of plates, as well historical as emblematical; which, however, were chiefly for books. But his best works are portraits; and of these he produced a considerable number, which are esteemed. They are mostly after Vandyck.—He also engraved historical subjects, from Poussin, Raphael, Annibal Carracci, Guido, and other masters.

LOMENTACEÆ, in *Botany*, (from *lomentum*, a colour used by painters), the name of the 33d order in Linnæus's Fragments of a Natural Method, consisting of the following genera, many of which furnish beautiful tinctures that are used in dyeing, viz. adenanthera, bauhinia, cæsalpina, cassia, ceratonia, cercis, gleditsia, guilandina, hæmatoxylon, hymenæa, mimosa, parkinsonia, poinciana, polygama. See BOTANY.

LOCH-LOMOND, a large lake of Dunbarton or Lennox-shire in Scotland, of which Mr Pennant gives the following description. "Loch-Lomond, the last, the most beautiful of the Caledonian lakes. The first view of it from Tarbet presents an extensive serpentine winding amidst lofty hills; on the north, barren, black, and rocky, which darken with their shade that contracted part of the water. On the west side, the mountains are clothed near the bottoms with woods of oak quite to the water edge; their summits lofty, naked, and craggy. On the east side, the mountains are equally high; but the tops form a more even ridge parallel to the lake, except where Ben-Lomond, like Saul amidst his companions, overtops the rest. The upper parts were black and barren; the lower had great marks of fertility, or at least of industry, for the yellow corn was finely contrasted with the verdure of the groves intermixed with it.

"This eastern boundary is part of the Grampian hills, which extend from hence through the counties of Perth, Angus, Mearns, and Aberdeen. The road runs sometimes through woods; at others is exposed and naked; in some, so steep as to require the support of a wall; the whole the work of the soldiery: blessed exchange of instruments of destruction for those that give safety to the traveller, and a polish to the once inaccessible native! Two great headlands covered with trees separate the first scene from one totally different; the last is called the *Point of Firkin*. On passing this cape an expanse of water bursts at once on your eye, varied with all the softer beauties of nature. Immediately beneath is a flat covered with wood and corn: beyond, the headlands stretch far into the water, and consist of gentle risings; many have their surfaces covered with wood, others adorned with trees loosely scattered either over a fine verdure or the purple bloom of the heath. Numbers of islands are dispersed over the lake, of the same elevated form as the little capes, and wooded in the same manner; others just peep above the surface, and are tufted with trees; and numbers are so disposed as to form magnificent vistos between.

"Opposite Luss, at a small distance from shore, is a mountainous isle almost covered with wood; it is near half a mile long, and has a most fine effect. I could not count the number of islands, but was told there are 28; the largest two miles long, and stocked with deer.

"The length of this charming lake is 24 miles; its greatest breadth 8; its greatest depth, which is between the point of Firkin and Benlomond, is 120 fathoms. Besides the fish common to the lochs are guiniads, called here *poans*.

"The surface of Loch-lomond has for several years past been observed gradually to increase, and invade the adjacent shore: and there is reason to suppose that churches, houses, and other buildings, have been lost in the water. Near Luss is a large heap of stones at a distance from the shore, known by the name of the old church; and about a mile to the south of that, in the middle of a large bay, between Camstraddan and the isle Inch-tavanack, is another heap, said to have been the ruins of a house. To confirm this, it is evident by a passage in Camden's Atlas Britannica, that an island, existing in his time, is now lost; for he speaks of the isle of Camstraddan, placed between the lands of the same name and Inch-tavanack, in which, adds he, was an house and orchard. Besides this proof, large trees with their branches still adhering are frequently found in the mud near the shore, overwhelmed in former times by the increase of water. This is supposed to be occasioned by the vast quantities of stone and gravel that are continually brought down by the mountain rivers, and by the falls of the banks of the Leven; the first filling the bed of the lake, the last impeding its discharge through the bed of the river."

LOMONOZOF, a celebrated Russian poet, the great refiner of his native tongue, was the son of a dealer in fish at Kolmogori: he was born in 1711, and was fortunately taught to read; a rare circumstance at that time for a person of his station in Russia. His natural genius for poetry was first kindled by the perusal of the Song of Solomon, done into verse by Polotski, whose rude compositions, perhaps scarcely superior to our version of the psalms by Sternhold and Hopkins, inspired him with such an irresistible passion for the muses, that he fled from his father, who was desirous of compelling him to marry, and took refuge in the Kaikonospaski monastery at Moscow; there he had

Lomonozof. had an opportunity of indulging his taste for letters, and of studying the Greek and Latin languages. In this seminary he made so considerable progress in polite literature, as to be noticed and employed by the Imperial Academy of Sciences. In 1736 he was sent at the expence of that society, to the university of Marpurg in Hesse Cassel, where he became a scholar of the celebrated Christian Wolf, under whom he studied universal grammar, rhetoric, and philosophy. He continued at Marpurg four years, during which time he applied himself with indefatigable diligence to chemistry, which he afterwards pursued with still greater success under the famous Henckel at Freyberg in Saxony. In 1741 he returned into Russia; was chosen in 1742 adjunct to the Imperial Academy; and in the ensuing year member of that society and professor of chemistry. In 1760 he was appointed inspector of the seminary then annexed to the academy; in 1764 he was gratified by the late empress with the title of counsellor of state; and died April 4th that year, in the 54th year of his age. Lomonozof excelled in various kinds of composition: but his chief merit, by which he bears the first rank among the Russian writers, is derived from his poetical compositions, the finest of which are his odes. The first was written in 1739, while he studied in Germany, upon the taking of Kotschin, a fortress in Crim Tartary, by Marshal Munich. The odes of Lomonozof are greatly admired for originality of invention, sublimity of sentiment, and energy of language; and compensate for the turgid style which, in some instances, has been imputed to them, by that spirit and fire which are the principal characteristics in this species of composition. Pindar was his great model; and if we may give credit to a person well versed in the Russian tongue, he has succeeded in this daring attempt to imitate the Theban bard, without incurring the censure of Horace. In this, as well as several other species of composition, he enriched his native language with various kinds of metre, and seems to have merited the appellation bestowed upon him of the *Father of Russian Poetry*. A brief recapitulation of the principal works of Lomonozof, which were printed in three volumes octavo, will serve to show the versatility of his genius, and his extensive knowledge in various branches of literature. The first volume, besides a Preface on the advantages derived to the Russian tongue from the ecclesiastical writings, contains ten sacred and nineteen panegyric odes, and several occasional pieces of poetry. The second comprises An Essay in Prose on the Rules for Russian Poetry; Translation of a German Ode; Idylls; Tamira and Selim, a tragedy; Demophoon, a tragedy; Poetical Epistle on the Utility of Glass; two cantos of an epic poem, entitled, Peter the Great; A Congratulatory Copy of Verses; An Ode; Translation of Baptist Rousseau's Ode *Sur le Bonheur*; Heads of a Course of Lectures on Natural Philosophy; certain passages translated in verse and prose, according to the original, from Cicero, Erasmus, Lucian, Ælian, Ammianus Marcellinus, Quintus Curtius, Homer, Virgil, Martial, Ovid, Horace, and Seneca, which Russian translations were brought as examples in his Lectures upon Rhetoric; lastly, Description of the Comet which appeared in 1744. The third volume consists chiefly of Speeches and Treatises read before the Academy; Panegyric on the Empress Elizabeth; on Peter the Great; Treatise on the Advantages of Chemistry; on the Phenomena of the Air occasioned by the Electrical Fire, with a Latin translation of the same; on the Origin of Light as a new Theory of Colours; Methods to determine with precision the Course of a Vessel; on the origin of Metals by the means of Earthquakes; Latin Dissertation on Solidity and Fluidity; on the Transit of Venus in 1761, with a German translation. Besides these various subjects, Lomonozof made no inconsiderable figure in history, having published two small works relative to that of his own country. The first, styled Annals of the Russian Sovereigns, is a short chronology of the Russian monarchs; and the second is, the Ancient History of Russia, from the Origin of that Nation to the Death of the Great Duke Yaroslaf I. in 1054; a performance of great merit, as it illustrates the most difficult and obscure period in the annals of this country.

London.

LONDON, a large city of Middlesex in England, the metropolis of Great Britain, and one of the most wealthy and populous cities in the world, is situated on the river Thames, in 51° 31′ north latitude, 400 miles south of Edinburgh, and 270 south-east of Dublin; 180 miles west of Amsterdam, 210 north-west of Paris, 500 south-west of Copenhagen, 600 north-west of Vienna, 790 south-west of Stockholm, 800 north-east of Madrid, 820 north-west of Rome, 850 north-east of Lisbon, 1360 north-west of Constantinople, and 1414 south-west of Moscow.

1 Its different names.

This city was by the Romans first called *Londinium* or *Lundinum*, as we find it in Tacitus, Ptolemy, Antoninus, and Ammianus. That name was afterwards changed into *Augusta*; in honour, as some say, of Helena Augusta, the mother of Constantine the Great; while others think it more probable that it had this name from the second legion, whose peculiar title was *Augusta*; and some imagine that the honourable appellation of *Augusta* was conferred upon this city by the Romans, as upon other principal cities of their empire, on account of its being grown up to be the capital of their British province. How long the name of *Augusta* prevailed, is not now certainly known; but after the establishment of the Saxons we find no more mention of Augusta. It was then called *Caer Lundain*, *Lundoun Byrig*, *Lunden Ceaster*, *Lunden-wye*, *Lundenne*, *Lunden-berh* or *Lundenburg*; since the conquest the records call it *Londinia*, *Lundonia*, *Londine*, *Londres*; and, for several ages past, it has been called *London*, a manifest corruption from Tacitus's *Londinium*. The most probable derivation of these names appears to be, either from the British words *lhong*, "a ship," and *din*, "a town," i. e. a town or harbour for ships; or from *Llin* "a lake," i. e. *Llin din*, "the town upon the lake," the Surry side being supposed, upon very probable grounds, to have been anciently a great expanse of water.

When founded.

Londinium, however, was not the primitive name of this famous place, which existed before the invasion of the Romans; being, at the time of Cæsar's arrival in the island, the capital of the *Trinobantes* or *Trinouantes*. The name of this nation, as appears from Baxter's British Glossary *, was derived from the three following British words, *tri*, *nou*, *hant*, which signify the "inhabitants of the new city." This name, it is supposed,

* p. 230.

ſuppoſed, might have been given them by their neighbours, on account of their having newly come from the continent into Britain, and having there founded a city called *tri-now*, or the "new city;" the moſt ancient name of the renowned metropolis of Britain. The Trinobantes had come ſo lately from Belgium, that they ſeem ſcarcely to have been firmly eſtabliſhed in Britain at the time of the firſt Roman invaſion: For their new city, which ſoon after became ſo famous, was then ſo inconſiderable, that it is not mentioned by Cæſar, though he muſt have been within ſight of the place where it was ſituated. His ſilence about this place, indeed, is brought as a proof that he did not croſs the Thames; while Norden by the *firmiſſima civitas* of the Trinobantes underſtands the city in queſtion, the Trinobantes themſelves having been among the firſt of the Britiſh ſtates who ſubmitted to that conqueror.

Henry's Hiſt. vol. i. p. 171.

By Ptolemy, and ſome other ancient writers of good authority, indeed, Londinium is placed in Cantium, or Cent, on the ſouth ſide of the Thames; and it is the opinion of ſome moderns, that the Romans probably had a ſtation there, to ſecure their conqueſts on that ſide of the river, before they reduced the Trinobantes. The place fixed upon for this ſtation is St George's Fields, a large plat of ground ſituated between Lambeth and Southwark, where many Roman coins, bricks, and checquered pavements, have been found. Three Roman ways from Kent, Surry, and Middleſex, interſected each other in this place; this therefore is ſuppoſed to be the original Londinium, which it is thought became neglected after the Romans reduced the Trinobantes, and ſettled on the other ſide of the Thames; and the name was transferred to the new city.

The ſituation of this city, as Mr Pennant obſerves, was juſt ſuch as the people would ſelect according to the rule eſtabliſhed among the Britons. An immenſe foreſt originally extended to the river ſide, and even as late as the reign of Henry II. covered the northern neighbourhood of the city, and was filled with various ſpecies of beaſts of chaſe. It was defended naturally by foſſes; one formed by the creek which run along Fleet-ditch, the other afterwards known by that of Wallbrook; the ſouth ſide was guarded by the Thames; the north they might think ſufficiently protected by the adjacent foreſt.

3
When taken poſſeſſion of by the Romans.

The Romans poſſeſſed themſelves of London, on their ſecond invaſion in the reign of Claudius, about 105 years after their firſt under Cæſar. They had begun with Camelodunum, the preſent Maldon in Eſſex; and having taken it, planted there a colony conſiſting of veterans of the 14th legion. London and Verulam were next taken poſſeſſion of about one and the ſame time. Camelodunum was made a *colonia* or place governed entirely by Roman laws and cuſtoms; Verulam (on the ſite of which St Alban's now ſtands), a *municipium*, in which the natives were honoured with the privileges of Roman citizens, and enjoyed their own laws and conſtitutions; and Londinium only a *præfectura*, the inhabitants, a mixture of Romans and Britons, being ſuffered to enjoy no more than the name of citizens of Rome, being governed by præfects ſent annually from thence, without having either their own laws or magiſtrates. "It was even then of ſuch concourſe (ſays Mr Pennant), and ſuch vaſt trade, that the wiſe conquerors did not think fit to truſt the inhabitants with the ſame privileges as other places of which they had leſs reaſon to be jealous." But others obſerve, that this is a miſtake; and that the Romans, in order to ſecure their conqueſt, and to gain the affections of thoſe Britons who had already ſubmitted to their authority, made London equally a municipium or free city with Verulamium, as may be ſeen by referring to Aulus Gellius, lib. xvi. c. 13. and to Spanhem. orbis Roman. tom ii. p. 37, 38.

It is difficult to ſay what were the particular articles of commerce exported from and imported into the port of London at this period. The imports and exports of the iſland in general we know: Strabo ſays, "Britain produceth corn, cattle, gold, ſilver, iron; beſides which, ſkins, ſlaves, and dogs, naturally excellent hunters, are exported from that iſland." It is probable that the two firſt and three laſt articles were exported from London; and perhaps, too, the *gagates* or jet-ſtone mentioned by Solinus as one of the productions of Britain, together with horſes, were exported from thence. The imports were at firſt ſalt, earthen ware, and works in braſs, poliſhed bits of bones emulating ivory, horſe collars, toys of amber, glaſſes, and other articles of the ſame material. 4

Ancient commerce of London.

In the reign of Nero, as Tacitus informs us, London was become a city highly famous for the great conflux of merchants, her extenſive commerce, and plenty of all things. No fewer than ſeven of the fourteen itinera of Antoninus begin or end at London; which tends to corroborate the many proofs which might be adduced, that this city was the capital of Britain in the Roman times.

At firſt London had no walls or other fortifications to defend it, and was therefore expoſed to the attacks of every enemy: and thus it ſuffered ſeverely about the year 64, being burnt by the Britons under Boadicea, and all the inhabitants maſſacred. But it was ſoon reſtored by the Romans; and increaſed ſo much, that in the reign of the emperor Severus it is called by Herodian a *great and wealthy city*. It continued, however, in a defenceleſs ſtate for more than a century after this laſt period; when at laſt a wall of hewn ſtone and Britiſh bricks was erected round it. 5

When firſt ſurrounded with walls.

London at this time extended in length from Ludgate-hill to a ſpot a little beyond the Tower. The breadth was not half equal to the length, and at each end grew conſiderably narrower. Maitland aſcribes the building of the walls to Theodoſius governor of Britain in 369. Dr Woodward, with more probability, ſuppoſes them to have been founded under the auſpices of Conſtantine the Great; and this ſeems to be confirmed by the numbers of coins of that emperor's mother Helena, which have been diſcovered under them, placed there by him in compliment to her. The ſame emperor made it a biſhop's ſee; for it appears that the biſhops of London and York, and another Engliſh biſhop, were at the council of Arles in the year 314: he alſo ſettled a mint in it, as is plain from ſome of his coins. The ancient courſe of the wall was as follows: It began with a fort near the preſent ſite of the Tower, was continued along the Minories, and the back of Houndſditch, acroſs Biſhopſgate-ſtreet, in a ſtraight line by London-wall to Cripplegate; then returned ſouthward by Crowder's Well alley 6

Their ancient courſe, &c.

alley (where ſeveral remnants of lofty towers were lately to be ſeen), to Alderſgate, thence along the back of Bull-and-Mouth-ſtreet to Newgate, and again along the back of the houſes in the Old Bailey to Ludgate; ſoon after which, it probably finiſhed with another fort, where the houſe, late the king's printing houſe, in Black Friars, now ſtands: from hence another wall ran near the river ſide, along Thames-ſtreet, quite to the fort on the eaſtern extremity. The walls were three miles a hundred and ſixty-five feet in circumference, guarded at proper diſtances on the land ſide with fifteen lofty towers; ſome of them were remaining within theſe few years, and poſſibly may ſtill. Maitland mentions one twenty-ſix feet high, near Gravel-lane, on the weſt ſide of Houndſditch; another, about eighty paces ſouth-eaſt towards Aldgate; and the baſes of another, ſupporting a modern houſe, at the lower end of the ſtreet called the Vinegar-yard, ſouth of Aldgate. The walls, when perfect, are ſuppoſed to have been twenty-two feet high, the towers forty. Theſe, with the remnants of the wall, proved the Roman ſtructure, by the titles and diſpoſition of the maſonry. London-wall, near Moorfields, is now the moſt entire part left of that ancient precinct. The gates which received the great military roads, were four. The Prætorian way, the Saxon Watling-ſtreet, paſſed under one, on the ſite of the late Newgate; veſtiges having been diſcovered of the road in digging above Holburn-bridge: it turned down to Dowgate, or more properly Dwr-gate or Water-gate, where there was a trajectus or ferry, to join it to the Watling-ſtreet, which was continued to Dover. The Hermin-ſtreet paſſed under Cripplegate; and a vicinal way went under Aldgate by Bethnal-green, towards Oldford, a paſs over the river Lee to Duroleiton, the modern Leiton in Eſſex.

7 London ſubmits to the Saxons.

After the Romans deſerted Britain, a new and fierce race ſucceeded. The Saxons, under their leaders Hengiſt and Horſa, landed in 448, having been invited over by the provincials as auxiliaries againſt the Scots and Picts; but quarrelling with their friends, they found means to eſtabliſh themſelves in the iſland, and in proceſs of time entirely ſubdued them, as related under the article ENGLAND, N° 31—44. London fell into the hands of thoſe invaders about the year 457; and became the chief city of the Saxon kingdom in Eſſex. It ſuffered much in the wars carried on between the Britons and Saxons: but it ſoon recovered; ſo that Bede calls it a *princely mart-town*, under the government of a chief magiſtrate, whoſe title of *portgrave*, or *portreve*, (for we find him called by both names), conveys a grand idea of the mercantile ſtate of London in thoſe early ages, that required a governor or guardian of the port. During the civil wars of the Saxons with each other, the Londoners had always the addreſs to keep themſelves neuter; and about the year 819, when all the ſeven Saxon kingdoms fell under the power of Egbert, London became the metropolis of England, which it has ever ſince continued.

8 Plundered by the Danes.

During the invaſions of the Danes, London ſuffered greatly. In 849, theſe invaders entered the Thames with 250 ſhips, plundered and burnt the city, and maſſacred the inhabitants; and two years after they returned with a fleet of 350 ſail, fully determined to deſtroy every thing that had eſcaped their barbarity in the former expedition. At this time, however, they were diſappointed; moſt of their troops being cut in pieces by King Ethelwolf and his ſon Athelbald; yet ſuch was the deſtruction made by thoſe barbarians at London, that it ſuffered more from theſe two incurſions than ever it had done before.

9 Recovers under Alfred the Great.

In the reign of King Alfred the Great, London began to recover from its former ruinous ſtate. He rebuilt its walls, drove out the Daniſh inhabitants who had ſettled there, reſtored the city to its former liberties and beauty, and committed the care of it to his ſon-in-law, Ethelred duke of Mercia, in hopes that this might always be a place of ſecure retreat within its ſtrong walls, whatever might happen from a foreign or domeſtic enemy. In 893, however, he had the mortification to ſee his capital totally reduced to aſhes by an accidental fire, which could not be extinguiſhed, as the houſes at that time were all built of wood. The walls, however, being conſtructed of incombuſtible materials, continued to afford the ſame protection as before; the houſes were quickly rebuilt, and the city divided into wards and precincts, for its better order and government. This king alſo inſtituted the office of ſheriff, the nature of which office made it neceſſary to have it alſo in London; ſo that here we have the glimmerings of the order of magiſtrates afterwards ſettled in the city of London: in the perſon of the portreve, or portgrave, or governor of the city, as ſupreme magiſtrate; in the ſheriff, and in the officer or ſubordinate magiſtrate by what name ſoever then diſtinguiſhed, which, being placed at the head of each ward or precinct, were analogous to the more modern title of *aldermen* and *common-council men*.

10 Reduced to aſhes.

11 Its government ſettled.

12 Brick and ſtone houſes firſt erected.

Alfred having ſettled the affairs of England in the moſt prudent manner, directed his attention to the ornamenting, as much as poſſible, the city of London. For this purpoſe, he ſpirited up the Engliſh to an emulation in building their houſes of ſtronger and more durable materials than formerly. At that time their houſes were moſtly of wood; and an houſe built of any other materials was looked upon as a kind of wonder. But Alfred having begun to raiſe his palaces of ſtone and brick, the opulent Londoners, and the nobility reſident in and about London, followed the example, though the cuſtom did not come into general uſe till ſome ages after.

13 Beſieged by Canute.

In 1015, a foreign enemy again appeared before London. Canute king of Denmark having invaded and plundered the counties of Dorſet, Somerſet, and Wilts, ſailed up the Thames with 200 ſhips, and laid ſiege to the city. The citizens continued faithful, notwithſtanding the defection of the greateſt part of the kingdom; and made ſuch a brave reſiſtance, that Canute thought fit to withdraw his army, leaving only his fleet to blockade the city by water, that when he found a fair opportunity he might renew the ſiege with better ſucceſs. At laſt, however, being defeated in ſeveral battles by Edmund Ironſide, he was obliged to call off his ſhips to cover his own army in caſe of neceſſity. In the compromiſe, however, which was afterwards made between Edmund and Canute, the city of London was given to the latter, and owned him for its lawful ſovereign. We have a ſtrong proof of the opulence of London even at this time, from the tax laid

upon

upon it by Canute in order to pay his army; this being no leſs than 10,500l. while the reſt of the nation was at the ſame time taxed only at 72,000l.

14 Sends repreſentatives to parliament.

In 1046, we have the firſt inſtance of the Londoners ſending repreſentatives to parliament. This happened on ſettling the ſucceſſion to the throne after Canute's death. The Engliſh in general declared for Edward ſon of King Ethelred; or, if that could not be carried, for Hardicanute, ſon of Canute by Queen Emma, and then abſent on a tour to Denmark. The city of London eſpouſed the claim and intereſt of Harold Harefoot, ſon alſo of Canute, by Queen Elgiva of Northampton. Edward's party ſoon declined; and the Londoners agreed, for the peace of the realm, that the two brothers ſhould divide the kingdom between them; but as Hardicanute did not return in proper time to England, a *wittena-gemote* was held at Oxford, where Earl Leofric, and moſt of the thanes on the north of the Thames, with the pilots of London, choſe Harold for their king. Here, by pilots we are to underſtand the directors, magiſtrates, or leading men of the city: and this manifeſtly ſhows, that London was then of ſuch conſequence, that no important national affair was tranſacted without the conſent of the inhabitants; for the Saxon annals aſſure us, that none were admitted into this aſſembly of election but the nobility and the pilots of London.

15 Suffers greatly by fires, hurricanes, &c.

On the invaſion of the Normans under William I. London ſubmitted as well as the reſt of the kingdom; and received two charters from that prince, confirming all the privileges they had under the Saxon kings, and adding ſeveral new ones. But while the citizens were promiſing themſelves all manner of ſecurity and tranquillity under the new government, it was almoſt entirely reduced to aſhes by an accidental fire in 1077. It had ſcarce recovered from this calamity, when it was viſited by another of the ſame kind in 1086, which began at Ludgate and deſtroyed the beſt and moſt opulent part of the city; conſuming, among other buildings, the cathedral of St Paul's; which, however, was ſoon rebuilt more magnificently than before. Under the reign of William Rufus, London ſuffered conſiderably by fires, hurricanes, and inundations, and ſeems to have been depreſſed by the tyranny of that prince; but Henry I. granted large immunities to the city, which again revived its trade, and was favourable to the progreſs of the arts. The king, however, ſtill retained the privilege of appointing the portreve, or chief magiſtrate; but the immunities granted to the Londoners ſecured their affections, and tended much to ſecure him on the throne. At the ſame time, there was ſuch a plenty of all kinds of proviſions, that as much corn was ſold for 1s. as would ſuffice 100 people for a day; 4d. would purchaſe as much hay and corn as would maintain 20 horſes for a day; and a ſheep could be bought for a groat.

16 Monſtrous licentiouſneſs of the Normans.

Henry thought proper alſo to check the licentious behaviour of the Normans, which, by the favour ſhowed them under the two Williams, had carried them into the moſt barbarous practices. Thoſe who followed William Rufus in his excurſions, haraſſed and plundered the country at diſcretion. Many of them were ſo extravagant in their barbarity, that what they could not eat or drink in their quarters, they either obliged the people to carry to market and ſell for their uſe, or elſe they would throw it into the fire: and, at their going off, they frequently waſhed their horſes heels with the drink, and ſtaved the caſks containing the remainder. King Henry reſolved to put a ſtop to theſe exceſſes and ſavage cuſtoms; and therefore publiſhed a proclamation at London, commanding that thenceforward all perſons who ſhould be convicted of ſuch barbarities ſhould have their eyes pulled out, or their hands or feet cut off, as the miniſters of juſtice ſhould think fit. This effectually checked the inſolence of the Normans, and the city continued to flouriſh throughout the reigns of Henry I. and Stephen. The attachment of the citizens to Stephen, however, was a crime which never could be forgiven by Henry II. and, of conſequence, he made them ſenſible of his diſpleaſure, by making frequent demands of money from them. About this time, indeed, the Londoners were arrived at ſuch a pitch of licentiouſneſs, that their proſperity ſeemed a curſe rather than a bleſſing. The ſons of the moſt eminent and wealthy citizens entered into a confederacy to commit burglaries, and to rob and murder all that came in their way in the night-time. The king took an opportunity from theſe irregularities to enrich himſelf. He demanded ſeveral loans and free gifts; till at laſt the Londoners, to prevent further inquiries into their conduct, paid into the exchequer 5000l. in three years. Theſe diſorders, however, were at laſt ſtopped by the execution of John Senex; who, though a very rich and reputable citizen, had engaged in theſe enterpriſes. He offered 500lb. weight of ſilver, a prodigious ſum in thoſe days, for his pardon, but was refuſed. The king, however, ſtill continued to drain the citizens of their money by free gifts; and at laſt fined every ſeparate guild, fraternity, or company, that had preſumed to act as bodies corporate without the royal letters-patent.

17 Of the Londoners.

18 The office of mayor when firſt inſtituted.

On the death of Henry II. the title of the firſt magiſtrate of London was changed from *portgreve* to that of *bailiff*; and in 1189 claimed and acted in the office of the *chief butler* at the coronation of Richard I. In 1191 this monarch permitted the bailiff, named *Henry Fitz-Alwine*, to aſſume the title of *mayor*. For, in 1192, we find certain orders of the mayor and aldermen to prevent fires; whereby it was ordained, that "all houſes thereafter to be erected in London and the liberties thereof, ſhould be built of ſtone, with party-walls of the ſame; and covered either with ſlates or tiles, to prevent thoſe dreadful calamities by fire, which were frequently and chiefly occaſioned by houſes built of wood, and thatched with ſtraw or reeds." And for this purpoſe, it was alſo provided by the diſcreeter men of the city, "that 12 aldermen of the city ſhould be choſen in full huſtings, and there ſworn to aſſiſt the mayor in appeaſing contentions that might ariſe among neighbours in the city upon encloſure betwixt land and land, and to regulate the dimenſions of party-walls, which were to be of ſtone, 16 feet high and three feet thick; and to give directions about girders, windows, gutters, and wells." Such confidence alſo did Richard put in the wiſdom and faithfulneſs of the city of London, that when it was reſolved to fix a ſtandard for weights and meaſures for the whole realm, his majeſty committed the execution thereof to the ſheriffs of London and Middleſex, whom he commanded to provide meaſures, gallons, iron rods, and

London.

and weights, for ſtandards, to be ſent to the ſeveral counties of England. This happened in 1198, at which time corn was advanced to the enormous price of 18s. 4d. per quarter.

19 Favours granted to the city by King John.

The city of London was much favoured by King John, who granted them three charters ſoon after his acceſſion. The firſt was a recital and confirmation of thoſe granted by Henry I. and II. with the farther privilege of being free from toll and every other duty or cuſtom in his majeſty's foreign dominions; for which they paid the ſum of 3000 merks. The ſecond was a confirmation of one granted by King Richard. By this the citizens of London had the juriſdiction and conſervancy of the river Thames; with a clauſe to extend that juriſdiction, and the powers therewith granted, to the river Medway; and with another clauſe to enable the ſaid city, as conſervators of the rivers Thames and Medway, to inflict a penalty of 10l. upon any perſon that ſhould preſume to erect a wear in either of theſe rivers. The third charter contains a fee-farm-rent of the ſheriffwicks of London and Middleſex at the ancient rent, of which they had been deprived by Queen Maud; granting them alſo the additional power of chooſing their own ſheriffs. This charter was given by way of conveyance from the crown to the citizens for a valuable conſideration, by which the ſheriffwick became their freehold; and this is the firſt covenant or conveyance we find on record with the legal terms of *to have and to hold*, which are at this time accounted an eſſential part in all conveyances of property.

20 London oppreſſed by Henry III.

During the reign of Henry III. the city of London was oppreſſed in many different ways. In 1218, he exacted a fine of 40 marks for ſelling a ſort of cloth not two yards within the liſts; and a 15th of the citizens perſonal eſtates for the enjoyment of their ancient rights and privileges. In 1221, he commanded by proclamation all the foreign merchants to depart the city, which drew 30 marks from the Hanſeatic company of the *Steelyard*, to have ſeiſin of their guild or hall in Thames-ſtreet. But it was the wreſtling match at St Giles's in the fields that brought on their greateſt burden. In the year 1221, on St James's day, the citizens of London having carried off the victory from the people of Weſtminſter and other neighbouring villages, the ſteward of the abbot of Weſtminſter, meditating revenge againſt the Londoners, propoſed another wreſtling match with them, and gave a ram for the prize. The citizens reſorted to the place at the time appointed; but were unexpectedly aſſaulted by a great number of armed men, who killed and wounded many, and diſperſed the reſt. This raiſed a great commotion in the city. The populace breathed revenge; and, by the inſtigation of Conſtantine Fitz-Arnulph, a great favourer of the French party during the troubles in King John's reign, they proceeded to Weſtminſter, and pulled down the houſes both of the ſteward and abbot. Hearing afterwards that the abbot was come into the city with his complaint to Philip d'Aubney the king's counſel, they purſued him, beat his ſervants cruelly, took away 12 of his horſes, and would have murdered himſelf, had he not eſcaped by a back-door. Upon this tumult, Hubert de Bury, then chief juſticiary, ſummoned the mayor and many of the principal citizens to attend him in the tower of London; and inquiring for the authors of the riot, Conſtantine, the ringleader boldly anſwered, that "he was one; that they had done no more than they ought; and that they were reſolved to avow what they had done, let the conſequence be what it would." In this he was ſeconded by his nephew and one Geoffrey: but the juſticiary, having diſmiſſed all the reſt, detained theſe three, and ordered them to be hanged next morning, though Conſtantine offered 15,000 marks for his pardon. Hubert then coming into the city with a ſtrong guard, cauſed the hands and feet of moſt of the principal rioters he could ſeize to be cut off: all which was executed without any legal proceedings or form of trial. After theſe arbitrary cruelties, he degraded the mayor and all the magiſtrates; placed a *cuſtos* over the city, and obliged 30 perſons of his own chooſing to become ſecurities for the good behaviour of the whole city. Several thouſand marks were alſo exacted by the king, before he would conſent to a reconciliation.

This arbitrary conduct alarmed the whole nation. The parliament of 1224 began to be uneaſy for themſelves, and addreſſed his majeſty that he would be pleaſed to confirm the charter of liberties which he had ſworn to obſerve; and the conſequence of this application was a confirmation of the magna charta in the full parliament at Weſtminſter in the year 1225. At this time alſo, the rights and privileges of the citizens were confirmed. They were exempted from proſecution for burels, i. e. liſted cloth; and were granted the right of having a common ſeal. The neceſſitous circumſtances of this monarch, however, made him often exact money arbitrarily as long as he lived.

Under the ſucceeding reigns, as the liberty of the people in general, was augmented, ſo the liberty, opulence, and power of the citizens of London increaſed, until they became a kind of balance to the power of the crown itſelf, which in ſome meaſure they ſtill continue to be. Riots indeed, for which they generally ſuffered, were by no means unfrequent; the city often ſuffered by fires and plagues. Nothing, however, happened which materially affected the welfare of the city, till the reign of Charles II. in 1665.—This year London was ravaged by the moſt violent plague ever known in Britain. The whole ſummer had been remarkably ſtill and warm, ſo that the weather was ſometimes ſuffocating even to people in perfect health; and by this unuſual heat and ſultry atmoſphere, people were undoubtedly prepared for receiving the infection, which appeared with violence in the months of July, Auguſt, and September. A violent plague had raged in Holland in the year 1663; on which account the importation of merchandiſe from that country was prohibited by the Britiſh legiſlature in 1644. Notwithſtanding this prohibition, however, it ſeems the plague had actually been imported; for in the cloſe of the year 1664, two or three perſons died ſuddenly in Weſtminſter, with marks of the plague on their bodies. Some of their neighbours, terrified at the thoughts of their danger, removed into the city; but their removal proved too late for themſelves, and fatal to thoſe among whom they came to reſide. They ſoon died of the plague; and communicated the infection to ſo many others, that it became impoſſible to extinguiſh the ſeeds of it, by ſeparating thoſe that were infected from ſuch as

21 Dreadful plague in 1665.

were

London. were not. It was confined, however, through a hard frosty winter, till the middle of February, when it again appeared in the parish of St Giles's, to which it had been originally brought; and, after another long rest till April, showed its malignant force afresh, as soon as the warmth of the spring gave it opportunity. —At first, it took off one here and there, without any certain proof of their having infected each other, and houses began to be shut up, with a design to prevent its spreading. But it was now too late; the infection gained ground every day, and the shutting up of houses only made the disease spread wider. People, afraid of being shut up, and sequestered from all communication with society, concealed their illness, or found means to escape from their places of confinement; while numbers expired in the greatest torments, destitute of every assistance; and many died both of the plague and other diseases, who would in all probability have recovered, had they been allowed their liberty, with proper exercise and air.—A house was shut up on account of a maid-servant, who had only spots, and not the gangrenous plague-blotches, upon her, so that her distemper was probably a petechial fever. She recovered; but the people of the house obtained no liberty to stir, either for air or exercise, for 40 days. The bad air, fear, anger, and vexation, attending this injurious treatment, cast the mistress of the family into a fever. The visitors appointed to search the house, said it was the plague, though the physicians were of a different opinion: the family, however, were obliged to begin their quarantine anew though it had been almost expired before; and this second confinement affected them so much, that most of the family fell sick, some of one distemper and some of another. Every illness that appeared in the family produced a fresh prolongation of their confinement; till at last the plague was actually brought in by some of those who came to inquire into the health of the family, and almost every person in the house died.—Many examples of a similar kind happened, and this was one of the worst consequences of shutting up houses. All means of putting a stop to the infection were evidently ineffectual. Multitudes fled into the country; many merchants, owners of ships, &c. shut themselves up, on board their vessels, being supplied with provisions from Greenwich, Woolwich, and single farm houses on the Kentish side. Here, however, they were safe; for the infection never reached below Deptford, though the people went frequently on shore to the country towns, villages, and farm houses, to buy fresh provisions. As the violence of the plague increased, the ships which had families on board removed farther off; some went quite out to sea, and then put into such harbours and roads as they could best get at.

In the mean time, the distemper made the most rapid advances within the city. In the last week of July, the number of burials amounted to 2010; but the first week of August it rose to 3817; thence to 3880; then to 4237; the next week, to 6102; and at last to 7000 and 8000 weekly. In the last week of September, however, the fury of the disease began to abate; though vast numbers were sick, yet the number of burials decreased from 7155 to 5538; the next week there was a farther decrease to 4929, then to 4327, next to 2665, then to 1421, and the next week to 1031. London.

All this while, the poor people had been reduced to the greatest distresses, by reason of the stagnation of trade, and the sicknesses to which they were peculiarly liable on account of their manner of living. The rich, however, contributed to their subsistence in a most liberal manner. The sums collected on this occasion are indeed almost incredible; being said to amount to 100,000l. per week. The king is reported to have contributed 1000l. weekly; and in the parish of Cripplegate alone, 17,000l. was distributed weekly among the poor inhabitants.—By the vigilance also of the magistrates, provisions continued remarkably cheap throughout the whole time of this dreadful calamity, so that all riots and tumults on that account were prevented; and at last, on the cessation of the disease in the winter of 1665, the inhabitants who had fled returned to their habitations, and London to appearance became as populous as ever, though it was computed that 100,000 persons had been carried off by the plague. 22

Account of the great fire in 1666.

The city was scarcely recovered from the desolation occasioned by the plague, when it was almost totally laid in ashes by a most dreadful fire. This broke out in a baker's shop in Pudding-lane, on Saturday night, September 2. 1666. In a few hours Billingsgate ward was entirely burnt down; and before morning the fire had crossed Thames-street, and destroyed the church of St Magnus. From thence it proceeded to the bridge, and consumed a great pile of buildings there; but was stopped by the want of any thing more to destroy. The flames, however, being scattered by a strong east wind, continued their devastations in other quarters. All efforts to stop it proved unsuccessful throughout the Sunday. That day it proceeded up as far as Garlick-hithe; and destroying Canon-street, invaded Cornhill and the Exchange. On Monday, the flames having proceeded eastward against the wind through Thames-street, invaded Tower-street, Gracechurch-street, Fenchurch-street, Dowgate, Old Fish-street, Watling-street, Threadneedle-street, and several others, from all which it broke at once into Cheapside. In a few hours Cheapside was all in flames, the fire having reached it from so many places at once. The fire then continuing its course from the river on one side, and from Cheapside on the other, surrounded the cathedral of St Paul's. This building stood by itself at some distance from any houses; yet such was the violence of the flames, and the heat of the atmosphere occasioned by them, that the cathedral took fire at top. The great beams and massy stones broke through into Faith-church underneath, which was quickly set on fire; after which, the flames invaded Pater-noster-row, Newgate-street, the Old Bailey, Ludgate-hill, Fleet-street, Ironmonger-lane, Old-Jewry, Laurence-lane, Milk-street, Wood-street, Gutter-lane, Foster-lane, Lothbury, Cateaton-street; and, having destroyed Christ-church, burnt furiously through St Martin's le Grand towards Aldersgate.

The fire had now attained its greatest extent, and was several miles in compass. The vast clouds of smoke obscured the sun so, that he either could not be seen at all, or appeared through it as red as blood. The flames reached an immense way up into the air, and their

London. their reflection from the ſmoke, which in the night-time ſeemed alſo like flame, made the appearance ſtill more terrible. The atmoſphere was illuminated to a great extent, and this illumination is ſaid to have been viſible as far as Jedburgh in Scotland. Some of the light aſhes alſo are ſaid to have been carried to the diſtance of 16 miles. Guildhall exhibited a ſingular appearance. The oak with which it was built was ſo ſolid that it would not flame, but burnt like charcoal, ſo that the building appeared for ſeveral hours like an enchanted palace of gold or burniſhed braſs.

At laſt, on Wedneſday morning, when every one expected that the ſuburbs as well as the city were to have been burnt, the fire began of itſelf to abate by reaſon of the wind having ceaſed, and ſome other changes no doubt taken place in the atmoſphere. It was checked by the great building in Leadenhall-ſtreet, and in other ſtreets by the blowing up ſeveral houſes with gun-powder; and on Thurſday the flames were quite extinguiſhed.—The following is a calculation of the damage done by this extraordinary conflagration.

23 Calculation of the damage done.

Thirteen thouſand two hundred houſes, at 12 years purchaſe, ſuppoſing the rent of each 25l. ſterling,	L. 3,960,000
Eighty-ſeven pariſh churches, at 8000l.	696,000
Six conſecrated chapels, at 2000l.	12,000
The royal exchange - -	50,000
The cuſtomhouſe - -	10,000
Fifty-two halls of companies, at 1500l. each - - -	78,000
Three city gates, at 3000l. each	9000
Jail of Newgate - -	15,000
Four ſtone bridges - -	6000
Seſſions houſe - -	7000
Guildhall, with the courts and offices belonging to it - -	40,000
Blackwell-hall - -	3000
Bridewell - - -	5000
Poultry compter - -	5000
Woodſtreet compter - -	3000
St Paul's church - -	2,000,000
Wares, houſehold ſtuff, money, and vemoable goods loſt or ſpoiled	2,000,000
Hire of porters, carts, waggons, barges, boats, &c. for removing goods	200,000
Printed books and paper in ſhops and warehouſes - - -	150,000
Wine, tobacco, ſugar, &c. of which the town was at that time very full - - -	1,500,000
	L. 10,689,000

It was never certainly known whether this fire was accidental or deſigned. A ſuſpicion fell upon the Papiſts; and this gained ſuch general credit, that it is aſſerted for a truth on the monument which is erected in memory of the conflagration. Of the truth of this aſſertion, however, though there was not ſufficient proof, it had the effect of making the Papiſts moſt violently ſuſpected and abhorred by the Proteſtants, which ſome time after proved very prejudicial to the city itſelf.

From this calamity, great as it was, London ſoon recovered itſelf, and became much more magnificent than before; the ſtreets, which were formerly crooked and narrow, being now built wide and ſpacious; and the induſtry of its inhabitants repaired the loſſes they had ſuſtained. In 1679, the city was again alarmed by the diſcovery of a deſign to deſtroy it by fire a ſecond time. Elizabeth Oxly, ſervant to one Rind in Fetter-lane, having ſet her maſter's houſe on fire, was apprehended on ſuſpicion, and confeſſed, that ſhe had been hired to do it by one Stubbs a Papiſt, for a reward of 5l. Stubbs being taken into cuſtody, acknowledged that he had perſuaded her to it; and that he himſelf had been prevailed upon by one Father Gifford his confeſſor, who had aſſured him, that by burning the houſes of heretics he would do a great ſervice to the church. He alſo owned that he had ſeveral conferences with Gifford and two Iriſhmen on the affair. The maid and Stubbs alſo agreed in declaring, that the Papiſts intended to riſe in London, expecting to be powerfully ſupported by a French army. In conſequence of this diſcovery, the Papiſts were baniſhed from the city, and five miles round, and five Jeſuits were hanged for the above-mentioned plot.

24 A deſign to ſet it on fire again.

The Papiſts thought to revenge themſelves by forging what was called the *meal-tub plot*, in which the Preſbyterians were ſuppoſed to hatch treacherous deſigns againſt the life of the king. Sir Edmondbury Godfrey alſo, who had been very active in his proceedings againſt the Papiſts, was murdered by ſome unknown perſons; and this murder, together with their diſcovering the falſehood of the meal-tub plot, ſo exaſperated the Londoners, that they reſolved to ſhow their deteſtation of Popery, by an extraordinary exhibition on the 17th of November, Queen Elizabeth's acceſſion to the throne, on which day they had uſually burnt the pope in effigy. The proceſſion began with a perſon on horſeback perſonating Sir Edmondbury Godfrey, attended by a bellman proclaiming his execrable murder. He was followed by a perſon carrying a large ſilver croſs, with prieſts in copes, Carmelites, and Gray-friars, followed by ſix Jeſuits: then proceeded divers waiters, and after them ſome biſhops with lawn ſleeves, and others with copes and mitres. Six cardinals preceded the pope, enthroned in a ſtately pageant, attended by divers boys with pots of incenſe, and the devil whiſpering in his ear. In this order they marched from Biſhopſgate to Fleet-ſtreet; and there, amidſt a great multitude of ſpectators, committed his holineſs to the flames.

25 Which gives occaſion to a quarrel with the court.

This proceſſion gave great offence to the court, at which the duke of York, afterwards James II. had a great influence. The breach was farther widened by the choice of ſheriffs for that year. The candidates ſet up by the court were rejected by a majority of almoſt two to one; but this did not deter their party from demanding a poll in their behalf, upon which a tumult enſued. This was repreſented by the Popiſh party in ſuch colours to the king, that he iſſued out a commiſſion that ſame evening for trying the rioters; which, however, was ſo far from intimidating the reſt, that they grew more and more determined, not only to oppoſe the Popiſh party, but to exclude the duke of York from his ſucceſſion to the crown.

London.

In the mean time, the king prorogued the parliament, to prevent them from proceeding in their inquiry concerning the Popiſh plot, and the excluſion-bill. Upon this the lord-mayor, aldermen, and common-council, preſented a petition to his majeſty, in which they requeſted, that he would permit the parliament to ſit in order to complete their ſalutary meaſures and councils. This petition was highly reſented by the king; who, inſtead of granting it, diſſolved the parliament, and could never afterwards be reconciled to the city. From this time it was determined to ſeize their charter; and freſh provocations having been given about the election of ſheriffs, a *quo warranto* was at laſt produced by the attorney-general, in order to overthrow their charter, and thereby to deprive the citizens of the power to chooſe ſheriffs.

26 A *Quo Warranto* granted againſt the city.

This information ſet forth, That "the mayor and commonalty and citizens of the city of London, by the ſpace of a month then laſt paſt and more, uſed, and yet do claim to have and uſe, without any lawful warrant or legal grant, within the city of London aforeſaid, and the liberties and privileges of the ſame city, the liberties and privileges following, viz. 1. To be of themſelves a body corporate and politic, by the name of *mayor and commonalty and citizens of the city of London.* 2. To have ſheriffs *civitat. et. com. London. et com. Middleſex*, and to name, make, and elect, and conſtitute them. 3. That the mayor and aldermen of the ſaid city ſhould be juſtices of the peace, and hold ſeſſions of the peace. All which liberties, privileges, and franchiſes, the ſaid mayor and commonalty, and citizens of London, upon the king did by the ſpace aforeſaid uſurp, and yet do uſurp."

Though nothing could be more unjuſt than this proſecution, the miniſtry were determined at all events to cruſh the Londoners; rightly judging, that it would be an eaſy matter to make all other corporations ſurrender their charters into the king's hands, and that they had no other body in the nation to fear. Accordingly they diſplaced ſuch judges as would not approve of their proceedings; and, on the 12th of June 1683, Juſtice Jones pronounced the following ſentence: "That a city might forfeit its charter; that the malverſations of the common council were acts of the whole city; and that the points ſet forth in the pleadings were juſt grounds for the forfeiting of a charter."

Notwithſtanding this ſentence, however, the attorney-general, contrary to the uſual cuſtom in ſuch caſes, was directed to move that the judgement might not be recorded: being afraid of the conſequences. Yet it was judged that the king might ſeize the liberties of the city. A common-council was immediately ſummoned to deliberate on this exigency. The country party moved to have the judgement entered; but they were overruled by the court party, who inſiſted upon an abſolute ſubmiſſion to the king before judgement was entered; and though this was in effect a voluntary ſurrender of the city-liberties, and deprived themſelves of the means of getting the judgement reverſed, the act of ſubmiſſion was carried by a great majority: and in a petition from the lord mayor, aldermen, and common-council, they "acknowledged their own miſgovernment, and his majeſty's lenity; begged his pardon, and promiſed conſtant loyalty and obedience; and humbly begged his majeſty's commands and directions."

London.

27 Conditions of reconciliation between the king and city.

To this his majeſty anſwered, that he would not reject their ſuit, if they would agree upon the following particulars. 1. That no lord mayor, ſheriff, recorder, common ſerjeant, town clerk, or coroner, of the city of London, or ſteward of the borough of Southwark, ſhall be capable of, or admitted to, the exerciſe of their reſpective offices before his majeſty ſhall have approved of them under his ſign-manual. 2. That if his majeſty ſhall diſapprove the choice of any perſon to be lord mayor, and ſignify the ſame under his ſign-manual to the lord mayor, or in default of a lord mayor, to the recorder or ſenior alderman, the citizens ſhall, within one week, proceed to a new choice: and if his majeſty ſhall in like manner diſapprove the ſecond choice, his majeſty may, if he pleaſes, nominate a perſon to be lord mayor for the year enſuing. 3. If his majeſty ſhall, in like manner, diſapprove the perſons choſen to be ſheriffs, or either of them, his majeſty may appoint ſheriffs for the year enſuing. 4. That the lord mayor and court of aldermen may, with the leave of his majeſty, diſplace any alderman, recorder, &c. 5. Upon the election of an alderman, if the court of aldermen ſhall judge and declare the perſon preſented to be unfit, the ward ſhall chooſe again; and upon a diſapproval of a ſecond choice, the court may appoint another in his room. 6. That the juſtices of the peace ſhould be by the king's commiſſion; and the ſettling of thoſe matters to be left to his majeſty's attorney-general and counſel learned in the law."

To theſe the lord-keeper added, in the king's name, "That theſe regulations being made, his majeſty would not only pardon this proſecution, but would confirm their charter in ſuch a manner as ſhould be conſiſtent with them; concluding thus: "My lord mayor, the term draws towards an end, and Midſummer-day is at hand, when ſome of the officers uſed to be choſen; whereof his majeſty will reſerve the approbation. Therefore, it is his majeſty's pleaſure, that you return to the city, and conſult the common-council, that he may ſpeedily know your reſolutions thereupon, and accordingly give his directions. That you may ſee the king is in earneſt, and the matter is not capable of delay, I am commanded to let you know he hath given orders to his attorney-general to enter upon judgement on Saturday next; unleſs you prevent it by your compliance in all theſe particulars."

A common-council was ſummoned, when the friends of liberty treated thoſe ſlaviſh conditions as they deſerved; and even declared, that they were ready to ſacrifice all that was near or dear to them, rather than ſubmit to ſuch arbitrary impoſitions: but when it was put to the vote, there appeared a majority of 18 for ſubmiſſion.

Thus the king got the government of the city into his own hands, though he and his brothers entirely loſt the affections of the Londoners. But, not content with their ſubmiſſion, his majeſty departed from his promiſe; commanded the judgement upon the *quo warranto* to be entered; and commiſſioned Sir William Pritchard, the lord mayor, to hold the ſame office during his majeſty's pleaſure. In the ſame manner he appointed or diſplaced the other magiſtrates as he thought proper; after

28 The king breaks his promiſe.

London. after which the miniftry, having nothing to fear, proceeded in the moft arbitrary manner.

29 Privileges of the city reftored. In this fubjection to the will of the court, the city of London continued till the Revolution; but, in 1689, the immediate reftoration of the Londoners to their franchifes was ordered; and in fuch a manner and form, as to put it out of the powers of an arbitrary miniftry and a corrupt judge and jury to deprive them of their chartered liberties for the time to come. Accordingly a bill was brought into parliament, and paffed, for reverfing the judgement of the *quo warranto* againft the city of London, and for reftoring the fame to its ancient rights and privileges. Since that time the city of London hath enjoyed tranquillity; its commerce hath been carried to the higheft pitch; and for the politenefs, riches, and number of its inhabitants, as well as is extent and the magnificence of its buildings, is inferior to no city in Europe, if not fuperior to every one.

30 Defcription of the city. That part of this immenfe capital which is diftinguifhed by the name of *The City*, ftands on the north fhore of the river, from the Tower to the Temple, occupying only that fpace formerly encompaffed by the wall, which in circumference meafures but three miles and 165 feet. In this wall there were feven gates by land, viz. Ludgate, Aldgate, Cripplegate, Alderfgate, Moorgate, Bifhopfgate, which were all taken down in September 1760; and Newgate, the county gaol, which was alfo taken down in 1776, and a maffive building erected a little fouth of it, which by the rioters in 1780 received damage to the amount of 80,000l. On the fide of the water there were Dowgate and Billingfgate, long fince demolifhed, as well as the poftern-gate near the Tower. In the year 1670 there was a gate erected called *Temple-Bar*, which terminates the bounds of the city weftward. The *liberties*, or thofe parts of this great city which are fubject to its jurifdiction, and lie without the walls of London, are bounded on the eaft, in Whitechapel, the Minories, and Bifhopfgate, by bars, which were formerly pofts and chains, that were frequently taken away by arbitrary power, when it was thought proper to feize the franchifes of the city of London: on the north, they are bounded in the fame manner in Pickaxe-ftreet, at the end of Fan-alley, and in St John's-ftreet: on the weft, by bars in Holborn: at the eaft end of Middle Row, and at the weft end of Fleet-ftreet, by the gate called *Temple-Bar*, already mentioned: on the fouth, we may include the jurifdiction which the city holds on the river Thames, and over the borough of Southwark.

The city, including the borough, is at prefent divided into 26 wards.

31 Divifion into wards. 1. *Alderfgate ward* takes its name from a city-gate which lately ftood in the neighbourhood. It is bounded on the eaft by Cripplegate ward; on the weft, by Farringdon ward within and without; and on the fouth, by Farringdon ward within. It is very large, and is divided into Alderfgate-within and Alderfgate-without. Each of thefe divifions confifts of four precincts, under one alderman, eight common-council men, of whom two are the alderman's deputies, eight conftables, fourteen inqueft-men, eight fcavengers, and a beadle; exclufive of the officers belonging to the liberty of St Martin's le Grand, which contains 168 houfes. London.

2. *Aldgate* takes its name alfo from a gate, which was of great antiquity, being mentioned in King Edgar's charter to the knights of the Knighton Guild about the year 967; and was probably of a much more ancient foundation, for it was the gate through which the Roman vicinal way lay to the ferry at Oldford. In the time of the wars betwixt King John and his barons, the latter entered the city through this gate, and committed great devaftations among the houfes of the religious. Aldgate was rebuilt by the leaders of the party after the Roman manner. They made ufe of ftone which they brought from Caen, and a fmall brick called the *Flanders tile*, which Mr Pennant thinks has been often miftaken for Roman. The new gate was very ftrong, and had a deep well within it. In 1471 this gate was affaulted by the Baftard of Falconbridge, who got poffeffion of it for a few hours; but the portcullis being drawn up, the troops which had entered were all cut off, and the citizens, headed by the alderman of the ward and recorder, having made a fally, defeated the remainder with great flaughter. In 1606 Aldgate was taken down and rebuilt; and many Roman coins were found in digging the foundations.—The ward of Aldgate is bounded on the eaft by the city wall, which divides it from Portfoken ward; on the north, by Bifhopfgate ward; on the weft, by Lime-ftreet and Langbourn wards; and on the fouth, by Tower-ftreet ward. It is governed by an alderman, fix common-council men, fix conftables, twenty inqueft-men, feven fcavengers, and a beadle; befides the officers belonging to St James's, Duke's Place.—It is divided into feven precincts.

3. *Baffifhaw* or *Bafinghall ward*, is bounded on the eaft and fouth by Coleman-ftreet ward, on the north by part of Cripplegate, and one the weft by part of the wards of Cheap and Cripplegate. On the fouth, it begins at Blackwell-hall; and runs northward to London-wall, pulled down fome time ago to make way for new buildings in *Fore-ftreet*, and fpreads 88 feet eaft, and 54 feet weft againft the place where that wall ftood. This is a very fmall ward, and confifts only of two precincts: the upper precinct contains no more than 66, and the lower only 76 houfes. It is governed by an alderman, four common-council men, of whom one is the alderman's deputy, three conftables, feventeen inqueft-men, three fcavengers, and a beadle. It has its name from Bafinghall, the manfion-houfe of the family of *Bafings*, which was the principal houfe in it, and ftood in the place of Blackwell-hall.

4. *Billingfgate ward* is bounded on the eaft by Tower-ftreet ward; on the north, by Langbourn ward; on the weft, by the ward of Bridge-within; and on the fouth, by the river Thames. There have been many conjectures concerning the origin of the name of *Billingfgate*, none of which feems to be very well authenticated. It is, for inftance, fuppofed to have derived its name from a Britifh king named *Belinus*, faid to have been an affiftant of Brennus king of the Gauls at the taking of Rome, and is the fame with the *Beli-Maur* mentioned in the Welfh genealogies. The name of *Ludgate* is faid to be derived from his fon

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London. *Lud.*—It is divided into 12 precincts; and is governed by an alderman, 10 common-council men, one of whom is the alderman's deputy, 11 constables, 14 inquest-men, six scavengers, and a beadle. The situation of Billingsgate, on the river, gives it great advantages with respect to trade and merchandise; so that it is well inhabited, and is in a continual hurry of business at the several wharfs or quays.

5. *Bishopsgate ward* is bounded on the east by Aldgate ward, Portsoken ward, and part of the Tower-liberty, or Norton-falgate; on the west, by Broad-street ward and Moorfields; and on the south, by Langbourn ward. It is very large, and divided into Bishopsgate-within and Bishopsgate-without. The first contains all that part of the ward within the city-wall and gate, and is divided into five precincts; the second lies without the wall, and is divided into four precincts. Bishopsgate-without extends to Shoreditch, taking its name from one Sir John de Sordich, an eminent lawyer much in favour with King Edward III. both on account of his knowledge in the law, and of his personal valour. In the time of Henry VIII. one Barlo, a citizen and inhabitant of this place, was named *duke of Shoreditch*, on account of his skill in archery; and, for a number of years after, the title belonged to the captain of the London archers. This ward is governed by an alderman, two deputies, one within and the other without, 12 common-council men, seven constables, 13 inquest-men, nine scavengers, and two beadles. It took its name from the gate, which has been pulled down to make that part of the city more airy and commodious. This gate was built by Erkenwald bishop of London in 675; and it is said to have been repaired by William the Conqueror soon after the Norman conquest. In the time of Henry III. the Hanse merchants had certain privileges confirmed to them, in return for which they were to support this gate; and in consequence of this they rebuilt it elegantly in 1479. There were two statues of bishops, in in memory of the founder and first repairer; other two were also put up, which are supposed to have been designed for Alfred and Ældred earl of Mercia to whose care the gate had been committed.

6. *Bread-street ward* is encompassed on the north and north-west, by the ward of Farringdon within; on the east, by Cordwainers ward; on the south by Queenhithe ward; and on the west, by Castle-Baynard ward. It is divided into 13 precincts; and is governed by an alderman, 12 common-council men, of whom one is the alderman's deputy, 13 constables, 13 inquest-men, 13 scavengers, and a beadle; and yet contains no more than 331 houses. It takes its name from the ancient bread-market, which was kept in the place now called *Bread-street;* the bakers being obliged to sell their bread only in the open market and not in shops.

7. *Bridge-ward within* is bounded on the south by the river Thames and Southwark; on the north, by Langbourn and Bishopsgate ward; on the east, by Billingsgate; and on the west, by Candlewick and Dowgate wards. It is divided into 14 precincts, three of which were on London bridge; and is governed by an alderman, 15 common-council men, one of whom is the alderman's deputy, 14 constables, 15 inquest-men, 14 scavengers, and a beadle. It takes its name from its connexion with London bridge. London.

8. *Broad-street ward* is bounded, on the north and east, by Bishopsgate ward; on the south, by Cornhill and Wallbrook ward; and on the west by Coleman-street ward. It is divided into 10 precincts; and governed by an alderman, 10 common-council men, one of whom is the alderman's deputy, 10 constables, 13 inquest-men, eight scavengers, and a beadle. It has its name from that part of it now distinguished by the name of *Old Broad-street;* and which, before the fire of 1666, was accounted one of the broadest streets in London.

9. *Candlewick ward*, *Candlewick-street*, or *Candle-wright-street ward* as it is called in some ancient records, is bounded on the east by Bridge ward; on the south, by Dowgate and part of Bridge ward; on the west, by Dowgate and Wallbrook; and on the north, by Langbourn ward. It is but a small ward, consisting of about 286 houses; yet is divided into seven precincts. It is governed by an alderman, eight common-council men, of whom one is the alderman's deputy, seven constables, 13 inquest-men, seven scavengers, and a beadle. It has its name from a street, formerly inhabited chiefly by candle wrights or candle-makers, both in tallow and wax: a very profitable business in the times of Popery, when incredible quantities of wax candles were consumed in the churches. That street, however, or at least its name, *Candlewick*, is lost since the great conflagration, for which the name *Canon-street* is substituted, the candle wrights being at that time burnt out and dispersed through the city.

10. *Castle-Baynard ward* is bounded by Queenhithe and Bread-street wards on the east; on the south, by the Thames; and on the west and north, by the ward of Farringdon-within. It is divided into 10 precincts, under the government of an alderman, 10 common-council men, one of whom is the alderman's deputy, nine constables, 14 inquest-men, seven scavengers, and a beadle. It takes its name from a castle built on the bank of the river by one Baynard, a soldier of fortune, who came in with William the Conqueror, and was by that monarch raised to great honours and authority.

11. *Cheap ward* is bounded on the east by Broad-street and Wallbrook wards; on the north, by Coleman-street, Bassishaw, and Cripplegate; and on the south, by Cordwainers ward. It is divided into nine precincts; and is governed by an alderman, 12 common-council men, of whom one is the alderman's deputy, 11 constables, 13 inquest-men, nine scavengers, and a beadle. It has its name from the Saxon word *chepe*, which signifies a market, kept in this division of the city, now called *Cheapside:* but then known by the name of *Westcheap*, to distinguish it from the market then also kept in Eastcheap, between Canon or Candlewick street and Tower-street.

12. *Coleman-street ward* is bounded on the east by Bishopsgate, Broadstreet, and Cheap wards; on the north, by Cripplegate ward, Middle Moorfields, and Bishopsgate; on the south, by Cheap ward; and on the west, by Bassishaw ward. It is divided into six precincts; and is governed by an alderman, six common-council

London. council men, one of whom is the alderman's deputy, ſix conſtables, 13 inqueſt-men, ſix ſcavengers, and a beadle. The origin of the name is not certainly known.

13. *Cordwainers ward* is bounded on the eaſt by Wallbrook, on the ſouth by Vintry ward, on the weſt by Bread-ſtreet, and on the north by Cheap ward. It is divided into eight precincts; and is governed by an alderman, eight common-council men, one of whom is the alderman's deputy, eight conſtables, 14 inqueſt-men, eight ſcavengers, and a beadle. Its proper name is *Cordwainers-ſtreet ward;* which it has from Cordwainers-ſtreet, now Bow-lane, formerly occupied chiefly by ſhoemakers and others that dealt or worked in leather.

14. *Cornhill ward* is but of ſmall extent. It is bounded on the eaſt by Biſhopſgate, on the north by Broad-ſtreet, on the weſt by Cheap ward, and on the ſouth by Langbourn ward. It is divided into four precincts, which are governed by one alderman, ſix common-council men, of whom one is the alderman's deputy, four conſtables, 16 inqueſt-men, four ſcavengers, and a beadle. It takes its name from the principal ſtreet in it, known from the earlieſt ages by the name of *Cornhill*, becauſe the corn-market was kept there.

15. *Cripplegate ward* is bounded on the eaſt by Moorfields, Coleman-ſtreet ward, Baſſiſhaw ward, and Cheap ward; on the north by the pariſh of St Luke's, Old-ſtreet; on the weſt, by Alderſgate ward; and on the ſouth, by Cheap ward. It is divided into 13 precincts, nine within and four without the wall; and is governed by an alderman, 12 common-council men, of whom two are the alderman's deputies, 13 conſtables, 34 inqueſt-men, 16 ſcavengers, and three beadles. It takes its name from Cripplegate, which ſtood on the north-weſt part of the city wall. It was an old plain ſtructure, void of all ornament, with one poſtern; but had more the appearance of a fortification than any of the other gates. It was removed in order to widen the entrance into Wood-ſtreet, which, by the narrowneſs of the gateway, was too much contracted and rendered dangerous for paſſengers and great waggons.

16. *Dowgate ward* is bounded on the eaſt by Candlewick and Bridge wards, on the north by Wallbrook ward, on the weſt by Vintry ward, and on the ſouth by the Thames. It is divided into eight precincts, under the government of an alderman, eight common-council men, of whom one is the alderman's deputy, eight conſtables, 15 inqueſt-men, five ſcavengers, and a beadle. It has its name from the ancient water gate, called *Dourgate*, which was made in the original wall that ran along the north ſide of the Thames, for the ſecurity of the city againſt all attempts to invade it by water.

17. *Farringdon ward within* is bounded on the eaſt by Cheap ward and Baynard-caſtle ward; on the north, by Alderſgate and Cripplegate wards, and the liberty of St Martin's le Grand; on the weſt by Farringdon-without; and on the ſouth, by Baynard-caſtle ward, and the river Thames. It is divided into 18 precincts; and governed by one alderman, 17 common-council men, of whom one is the alderman's deputy, 19 conſtables, 17 inqueſt-men, 19 ſcavengers, and two beadles, It takes its name from William Farringdom citizen and goldſmith of London, who, in 1279, purchaſed all the aldermanry with the appurtenances, within the city of London and ſuburbs of the ſame, between Ludgate and Newgate, and alſo *without* theſe gates.

18. *Farringdon ward without* is bounded on the eaſt by *Farringdon within*, the precinct of the late priory of St Bartholomew near Smithfield, and the ward of Alderſgate; on the north, by the Charter-houſe, the pariſh of St John's Clerkenwell, and part of St Andrew's pariſh without the freedom; on the weſt, by High Holborn and St Clement's pariſh in the Strand; and on the ſouth by the river Thames. It is governed by one alderman, 16 common-council men, of whom two are the alderman's deputies, 23 conſtables, 48 inqueſt-men, 24 ſcavengers, and four beadles. It takes its name from the ſame goldſmith who gave name to Farringdon within.

19. *Langbourn ward* is bounded on the eaſt by Aldgate ward; on the north, by part of the ſame, and Lime-ſtreet ward; on the ſouth, by Tower-ſtreet, Billingſgate, Bridge, and Candlewick wards; and on the weſt by Wallbrook. It is divided into 12 precincts. It had its name from a rivulet or long bourn of freſh water, which anciently flowed from a ſpring near Magpye alley adjoining to St Catherine Coleman's church.

20. *Limeſtreet ward* is bounded on the eaſt and north by Aldgate ward, on the weſt by Biſhopſgate; and on the ſouth by Langbourn ward. It is divided into four precincts; and governed by an alderman, four common-council men, one of whom is the alderman's deputy, four conſtables, 13 inqueſt-men, four ſcavengers, and a beadle. It is very ſmall; and has its name from ſome lime-kilns that were formerly built in or near Lime-ſtreet.

21. *Portſoken ward* is bounded on the eaſt by the pariſhes of Spitalfields, Stepney, and St George's in the eaſt; on the ſouth, by Tower-hill; on the north, by Biſhopſgate ward, and on the weſt by Aldgate ward. It is divided into five precincts; and is governed by an alderman, five common-council men, one of whom is the alderman's deputy, five conſtables, 19 inqueſt-men, five ſcavengers, and a beadle. Its name ſignifies the *franchiſe of the liberty gate.* This Portſoken was for ſome time a guild; and had its beginning in King Edgar, when 13 knights, "well beloved of the king and realm, for ſervices by them done," requeſted to have a certain portion of land on the eaſt part of the city left deſolate and forſaken of the inhabitants by reaſon of too much ſervitude. They beſought the king to have this land, with the liberty of a guild for ever. The king granted their requeſt on the following conditions, viz. that each of them ſhould victoriouſly accompliſh three combats, one above the ground, one under ground, and the third in the water: and after this, at a certain day, in Eaſt Smithfield, they ſhould run with ſpears againſt all comers. All this was glorioufly performed; upon which the king named it *Knighten Guild*, and extended it from Aldgate to the places where the bars now are on the eaſt, and to the Thames on the ſouth, and as far into the water as an horſeman could ride at low water and throw his ſpear.

22. *Queen-hithe ward* is bounded on the eaſt by Dowgate, on the north by Bread-ſtreet and Cord-

wainers

London. wainers wards, on the south by the Thames, and on the west by Castle-Baynard ward. It is divided into nine precincts; and is governed by one alderman, six common-council men, one of whom is the alderman's deputy, and nine constables. It has its name from the *hithe*, or harbour for large boats, barges, and lighters; for which, and even for ships, it was the anchoring place, and the quay for loading and unloading vessels almost of any burden used in ancient times. It has the name of *queen*, because the queens of England usually possessed the tolls and customs of vessels that unloaded goods at this hithe, which were very considerable.

23. *Tower ward*, or *Tower-street ward*, is bounded on the south by the river Thames, on the east by Tower-hill and Aldgate ward, on the north by Langbourn ward, and on the west by Billingsgate ward. It is governed by one alderman, 12 common-council men, of whom one is the alderman's deputy, 12 constables, 13 inquest-men, 12 scavengers, and one beadle. It takes its name from *Tower-street*, so called because it leads out of the city in a direct line to the principal entrance of the Tower of London.

24. *Vintry ward* is bounded on the east by Dowgate, on the south by the Thames, on the west by Queenhithe ward, and on the north by Cordwainers ward. It is a small ward, containing only 418 houses; but is divided into nine precincts, and governed by an alderman, nine common-council men, one of whom is the alderman's deputy, nine constables, 13 inquest-men, three scavengers, and a beadle. It takes its name from the vintners or wine-merchants of Bourdeux, who formerly dwelt in this part of the city, were obliged to land their wines on this spot, and to sell them in 40 days, till the 28th of Edward I.

25. *Wallbrook ward* is bounded on the east by Langbourn, on the south by Dowgate ward, on the west by Cordwainers ward, and on the north by Cheap ward. It is small, containing only 306 houses; but is divided into seven precincts, and governed by an alderman, eight common-council men, of whom one is the alderman's deputy, seven constables, 13 inquest-men, six scavengers, and a beadle. It has its name from the rivulet *Wall-brook*, that ran down the street of this name into the river Thames near Dowgate; but in process of time it was so lost by covering it with bridges, and buildings upon those bridges, that its channel became a common sewer.

26. The ward of *Bridge-without* includes the borough of Southwark, and the parishes of Rotherhithe, Newington, and Lambeth. It has its name from London bridge, with the addition of the word *without*, because the bridge must be passed in order to come at it. *Westminster* is generally reckoned a part of London, though under a distinct government; and has long been famous for the palaces of our kings, the seat of our law wribunals, and of the high court of parliament; all which shall be described in their order.

32 Government of London. The city and liberties of London are under an ecclesiastical, a civil, and a military government.

33 Ecclesiastical. As to its *ecclesiastical* government, London is a bishop's see, the diocese of which comprehends not only Middlesex, Essex, and part of Hertfordshire, but the British plantations in America. The bishop of London takes precedency next to the archbishops of Canterbury and York; but the following parishes of this city are exempt from his jurisdiction, being peculiars under the immediate government of the archbishop of Canterbury; viz. All-hallows in Bread-street, All-hallows, Lombard-street; St Dionys Back-church, St Dunstan in the East, St John Baptist, St Leonard Eastcheap, St Mary Aldermary, St Mary Bothaw, St Mary le Bow, St Michael Crooked-lane, St Michael Royal, St Pancras Soper-lane, and St Vedast Foster-lane. London.

The *civil* government of London divides it into wards and precincts, under a lord mayor, aldermen, and common-council. 34 Civil.

The mayor, or lord mayor, is the supreme magistrate, chosen annually by the citizens, pursuant to a charter of King John. The present manner of electing a lord mayor is by the liverymen of the several companies, assembled in Guildhall annually on Michaelmas-day, according to an act of common council in A. D. 1476, where, and when, the liverymen choose, or rather nominate, two aldermen below the chair, who have served the office of sheriff, to be returned to the court of aldermen, who may choose either of the two; but generally declare the senior of the two, so returned, to be lord mayor elect. The election being over, the lord mayor elect, accompanied by the recorder and divers aldermen, is soon after presented to the lord chancellor (as his majesty's representative in the city of London) for his approbation; and on the 9th of November following is sworn into the office of mayor at Guildhall; and on the day after, before the barons of the exchequer at Westminster; the procession on which occasion is exceedingly grand and magnificent. 35 Lord Mayor.

The lord mayor sits every morning at the mansion-house, or place where he keeps his mayoralty, to determine any difference that may happen among the citizens, and to do other business incident to the office of a chief magistrate. Once in six weeks, or eight times in the year, he sits as chief judge of oyer and terminer, or gaol-delivery of Newgate for London and the county of Middlesex. His jurisdiction extends all over the city and suburbs, except some places that are exempt. It extends also from Colneyditch, above Staines-bridge in the west, to Yeudale, or Yenflete, and the mouth of the river Medway, and up that river to Upnor-castle, in the east: by which he exercises the power of punishing or correcting all persons that shall annoy the streams, banks, or fish. For which purpose his lordship holds several *courts of conservancy* in the counties adjacent to the said river, for its conservation, and for the punishment of offenders. See the article MAYOR's-*Court*.

The title of dignity, *alderman*, is of Saxon original, and of the greatest honour, answering to that of earl; though now it is nowhere to be found but in chartered societies. And from hence we may account for the reason why the aldermen and commonalty of London were called *barons* after the conquest. These magistrates are properly the subordinate governors of their respective wards under the lord mayor's jurisdiction; and they originally held their aldermanries either by inheritance or purchase; at which time the aldermanries or wards changed their names as often as their governors or aldermen. The oppressions, to which the citizens were subject from such a government, put them upon 36 Aldermen.

upon means to abolish the perpetuity of that office and they brought it to an actual election. But that manner of election being attended with many inconveniences, and becoming a continual bone of contention among the citizens, the parliament, 17 Richard II. A. D. 1394, enacted, that the aldermen of London should continue in their several offices during life or good behaviour. And so it still continues: though the manner of electing has several times varied. At present it is regulated by an act of parliament, passed in the year 1724-5: and the person so elected is to be returned by the lord mayor (or other returning officer in his stead, duly qualified to hold a court of wardmote) to the court of lord mayor and aldermen, by whom the person so returned must be admitted and sworn into the office of alderman before he can act. If the person chosen refuseth to serve the office of alderman, he is finable 500l.

These high officers constitute a second part of the city legislature when assembled in a corporate capacity, and exercise an executive power in their respective wards. The aldermen who have passed the chair, or served the high office of lord mayor, are justices of the quorum; and all the other aldermen are not only justices of the peace, but by the statute of 43 Eliz. entitled, *An act for the relief of the poor*, "every alderman of the city of London, within his ward, shall and may do and execute, in every respect, so much as is appointed and allowed by the said act to be done or executed by one or *two* justices of peace of any county within this realm." They every one keep their *wardmote*, or *court*, for choosing ward-officers and settling the affairs of the ward, to redress grievances, and to present all defaults found within their respective wards.

37 Common-council.

The next branch of the legislative power in this city is the *common-council*. The many inconveniences that attended popular assemblies, which were called *folkmote*, determined the commonalty of London to choose representatives to act in their name and for their interest, with the lord mayor and aldermen, in all affairs relating to the city. At first these representatives were chosen out of the several companies: but that not being found satisfactory, nor properly the representatives of the whole body of the inhabitants, it was agreed to choose a certain number of discreet men out of each ward: which number has from time to time increased according to the dimensions of each ward: and at present the 25 wards, into which London is divided, being subdivided into 236 precincts, each precinct sends a representative to the common-council, who are elected after the same manner as an alderman, only with this difference, that as the lord mayor presides in the wardmote, and is judge of the poll at the election of an alderman, so the alderman of each ward is judge of the poll at the election of a common-council man.

Thus the lord mayor, aldermen, and common-council, when assembled, may be deemed the city parliament, resembling the great council of the nation. For it consists of two houses; one for the lord mayor and aldermen, or the upper house; another for the commoners or representatives of the people, commonly called the *common-council men*. And they have power in their incorporate capacity to make and repeal bye-laws; and the citizens are bound to obey or submit to those laws. When they meet in their incorporate capacity, they wear deep blue silk gowns: and their assemblies are called the *court of common-council*, and their ordinances *acts of common-council*. No act can be performed in the name of the city of London without their concurrence. But they cannot assemble without a summons from the lord mayor; who, nevertheless, is obliged to call a common-council, whenever it shall be demanded, upon extraordinary occasions, by six reputable citizens and members of that court.

38 Sheriffs.

This corporation is assisted by two sheriffs and a recorder. The sheriffs are chartered officers, to perform certain suits and services, in the king's name, within the city of London and county of Middlesex, chosen by the liverymen of the several companies on Midsummer day. Their office, according to Camden, in general, is to collect the public revenues within their several jurisdictions; to gather into the exchequer all fines belonging to the crown; to serve the king's writs of process; to attend the judges, and execute their orders; to impannel juries; to compel headstrong and obstinate men by the *posse comitatus* to submit to the decisions of the law; and to take care that all condemned criminals be duly punished and executed. In particular, in London, they are to execute the orders of the common-council, when they have resolved to address his majesty, or to petition parliament.

The sheriffs, by virtue of their office, hold a court at Guildhall every Wednesday and Friday, for actions entered at Wood-street Compter; and on Thursdays, and Saturdays for those entered at the Poultry Compter: of which the sheriffs being judges, each has his assistant, or deputy, who are called the judges of those courts; before whom are tried actions of debt, trespass, covenant, &c. and where the testimony of any absent witness in writing is allowed to be good evidence. To each of these courts belong four attornies, who, upon their being admitted by the court of aldermen, have an oath administered to them.

To each of these courts likewise belong a secondary, a clerk of the papers, a prothonotary, and four clerks-sitters. The secondary's office is to allow and return all writs brought to remove clerks out of the said courts, the clerk of the papers files and copies all declarations upon actions; the prothonotary draws and engrosses all declarations; the clerk-sitters enter actions and attachments, and take bail and verdicts. To each of the compters, or prisons belonging to these courts, appertain 16 serjeants at mace, with a yeoman to each, besides inferior officers, and the prison-keeper.

In the sheriffs court may be tried actions of debt, case, trespass, account, covenant, and all personal actions, attachments, and sequestrations. When an erroneous judgement is given in either of the sheriffs courts of the city, the writ of error to reverse this judgement must be brought in the court of hustings before the lord mayor; for that is the superior court. The sheriffs of London may make arrests and serve executions on the river Thames.

39 Recorder.

We do not read of a recorder till the 1304, who, by the nature of his office, seems to have been intended as an assistant to, or assessor with, the lord mayor, in the execution of his high office, in matters of justice and law. He is chosen by the lord mayor and alder-

London. men only; and takes place in all courts, and in the common-council, before any one that hath not been mayor. Of whom we have the following deſcription in one of the books of the chamber: "He ſhall be, as is wont to be, one of the moſt ſkilful and virtuous apprentices of the law of the whole kingdom; whoſe office is always to ſit on the right hand of the mayor, in recording pleas, and paſſing judgements; and by whom records and proceſſes, had before the lord mayor and alderman at Great St Martin's, ought to be recorded by word of mouth before the judges aſſigned there to correct errors. The mayor and aldermen have therefore uſed commonly to ſet forth all other buſineſſes, touching the city, before the king and his council, as alſo in certain of the king's courts, by Mr Recorder, as a chief man, endued with wiſdom, and eminent for eloquence."—Mr Recorder is looked upon to be the mouth of the city, to deliver all addreſſes to the king, &c. from the corporation; and he is the firſt officer in order of precedence that is paid a ſalary, which originally was no more than 10l. ſterling per annum, with ſome few perquiſites; but it has from time to time been augmented to 1000l. per annum, and become the road to preferment in the law. This office has ſometimes been executed by a deputy.

40 Chamberlain. The next chartered officer of this corporation is the chamberlain; an officer of great repute and truſt, and is in the choice of the livery annually. This officer, though choſen annually on Midſummer-day, is never diſplaced during his life, except ſome very great crime can be made out againſt him. He has the keeping of the moneys, lands, and goods, of the city orphans, or takes good ſecurity for the payment thereof when the parties come to age. And to that end he is deemed in the law a ſole corporation, to him and his ſucceſſors, for orphans; and therefore a bond or a recognizance made to him and his ſucceſſors, is recoverable by his ſucceſſors. This officer hath a court peculiarly belonging to him. His office may be termed a public treaſury, collecting the cuſtoms, moneys, and yearly revenues, and all other payments belonging to the corporation of the city. It was cuſtomary for government to appoint the chamberlain receiver of the land tax; but this has been diſcontinued for ſeveral years paſt.

41 Other officers. The other officers under the lord mayor are, 1. The common ſerjeant. He is to attend the lord mayor and court of aldermen on court days, and to be in council with them on all occaſions, within or without the precincts or liberties of the city. He is to take care of orphans eſtates, either by taking account of them, or to ſign their indentures, before their paſſing the lord mayor and court of aldermen. And likewiſe he is to let, ſet, and manage the orphans eſtates, according to his judgement, to the beſt advantage. 2. The town clerk; who keeps the original charter of the city, the books, rolls, and other records, wherein are regiſtered the acts and proceedings of the city; ſo that he may not be improperly termed the city-regiſter: he is to attend the lord mayor and aldermen at their courts, and ſigns all public inſtruments. 3. The city remembrancer; who is to attend the lord mayor on certain days, his buſineſs being to put his lordſhip in mind of the ſelect days he is to go abroad with the aldermen, &c. He is to attend daily at the parliament houſe, during the ſeſſions, and to report to the lord mayor their tranſactions. 4. The ſword-bearer; who is to attend the lord mayor at his going abroad, and to carry the ſword before him, being the emblem of juſtice. This is an ancient and honourable office, repreſenting the ſtate and princely office of the king's moſt excellent majeſty, in his repreſentative the lord mayor; and, according to the rule of armory, "He muſt carry the ſword upright, the hilts being holden under his bulk, and the blade directly up the midſt of his breaſt, and ſo forth between the ſword-bearer's brows." 5. The common hunt; whoſe buſineſs it is to take care of the pack of hounds belonging to the lord mayor and citizens, and to attend them in hunting in thoſe grounds to which they are authorized by charter. 6. The common crier. It belongs to him and the ſerjeant at arms, to ſummon all executors and adminiſtrators of freemen to appear, and to bring in inventories of the perſonal eſtates of freemen, within two months after their deceaſe: and he is to have notice of the appraiſements. He is alſo to attend the lord mayor on ſet days, and at the courts held weekly by the mayor and aldermen. 7. The water bailiff; whoſe office is to look after the preſervation of the river Thames againſt all encroachments; and to look after the fiſhermen for the preſervation of the young fry, to prevent the deſtroying them by unlawful nets. For that end, there are juries for each county, that hath any part of it lying on the ſides or ſhores of the ſaid river; which juries, ſummoned by the water bailiff at certain times, do make inquiry of all offences relating to the river and the fiſh, and make their preſentments accordingly. He is alſo bound to attend the lord mayor on ſet days in the week.—Theſe ſeven purchaſe their places; except the town clerk, who is choſen by the livery.

There are alſo three ſerjeant carvers; three ſerjeants of the chamber; a ſerjeant of the channel; four yeomen of the water ſide; an under water bailiff; two yeomen of the chamber; two meal weighters; two yeomen of the wood wharfs; a foreign taker; city marſhals. There are beſides theſe, ſeven gentlemen's men; as the ſword-bearer's man, the common hunt's two men, the common crier's man, and the carver's three men.

Nine of the foregoing officers have liveries of the lord mayor, viz. the ſword-bearer and his man, the three carvers, and the four yeomen of the water ſide. All the reſt have liveries from the chamber of London.

The following officers are likewiſe belonging to the city; farmer of the markets, auditor, clerk of the chamber, clerk to the commiſſioners of the ſewers, clerk of the court of conſcience, beadle of the ſame court, clerk of the city works, printer to the city, juſtice of the Bridge yard, clerk comptroller of the Bridge houſe, ſteward of the Borough, bailiff of the Borough.

There is alſo a coroner, called ſo from *corona*, i. e. a *crown*, becauſe he deals principally with the crown, or in matters appertaining to the imperial crown of England. See the article CORONER.

Beſides theſe officers, there are ſeveral courts in this city for the executing of juſtice, viz. the court of huſtings, lord mayor's court, &c. In the city there are alſo

London. alſo two ſubordinate kinds of government. One executed by the alderman, deputy, and common-council men, and their inferior officers, in each ward; under which form are comprehended all the inhabitants, free or not free of the city. Every ward is therefore like a little free ſtate, and at the ſame time ſubject to the lord mayor as chief magiſtrate of the city. The houſekeepers of each ward elect their repreſentatives, the common council, who join in making bye-laws for the government of the city. The officers and ſervants of each ward manage the affairs belonging to it, without the aſſiſtance of the reſt; and each has a court called the *wardmote*, as has been already deſcribed, for the management of its own affairs. The other, by the maſter, wardens, and court of aſſiſtants, of the incorporate companies; whoſe power reaches no farther than over the members of their reſpective guilds or fraternities; except that in them is veſted the power to chooſe repreſentatives in parliament for the city, and all thoſe magiſtrates and officers elected by a common hall; which companies are inveſted with diſtinct powers, according to the tenor of their reſpective charters.

42 Military government. The *military* government of the city is lodged in a lieutenancy, conſiſting of the lord mayor, aldermen, and other principal citizens, who receive their authority by a commiſſion from the king. Thoſe have under their command the city trained bands, conſiſting of ſix regiments of foot, diſtinguiſhed by the names of the *white*, *orange*, *yellow*, *blue*, *green*, and *red*, each containing eight companies of 150 men, amounting in all to 7200. Beſides theſe ſix regiments, there is a corps called the *artillery company*, from its being taught the military exerciſe in the artillery ground. This company is independent of the reſt, and conſiſts of 700 or 800 volunteers. All theſe, with two regiments of foot of 800 men each commanded by the lieutenant of the Tower of London, make the whole militia of this city; which, excluſive of Weſtminſter and the borough of Southwark, amounts to about 10,000 men.

43 Trading Companies. The *trading part* of the city of London is divided into 89 companies; though ſome of them can hardly be called ſo, becauſe they have neither charters, halls, nor liveries. Of theſe 89 companies, 55 have each a hall for tranſacting the buſineſs of the corporation; and this conſiſts of a maſter or prime warden, a court of aſſiſtants, and livery.—Twelve of theſe companies are ſuperior to the reſt both in antiquity and wealth; and of one of thoſe 12 the lord mayors have generally made themſelves free at their election. Theſe companies are the mercers, grocers, drapers, fiſhmongers, goldſmiths, ſkinners, merchant-taylors, haberdaſhers, ſalters, ironmongers, vintners, and clothworkers.—The principal incorporated ſocieties of the merchants of this city are, the Hamburgh Company, the Hudſon's Bay Company, the Ruſſia Company, the Turkey Company, the Eaſt India Company, the Royal African Company, the South Sea Company, and ſome Inſurance Companies. The moſt of theſe companies have ſtately houſes for tranſacting their buſineſs, particularly the Eaſt India and South Sea companies. See COMPANY.

44 Remarkable ſtreets and buildings within the City. The ſtreets and public buildings in London and its liberties being far too numerous for a particular deſcription in this work, we ſhall only ſelect the moſt remarkable, beginning with *London Bridge* as the moſt ancient, and proceeding in our ſurvey through the wards into which the city is divided.

45 London Bridge. I. *Remarkable buildings*, &c. *in the* CITY.—The original bridge, which ſtands in Bridge ward, was of wood, and appears to have been firſt built between the years 993 and 1016; but being burnt down about the year 1136, it was rebuilt of wood in 1163. The expences, however, of maintaining and repairing it became ſo burdenſome to the inhabitants of the city, that they reſolved to build a ſtone bridge a little weſtward of the wooden one. This building was begun in 1176, and finiſhed in 1209; and was 915 feet long, 44 feet high, and 73 feet wide; but houſes being built on each ſide, the ſpace between was only 23 feet.

This great work was founded on enormous piles driven as cloſely as poſſible together: on their tops were laid long planks 10 inches thick, ſtrongly bolted; and on them was placed the baſe of the pier, the lowermoſt ſtones of which were bedded in pitch, to prevent the water from damaging the work: round all were the piles which were called the *ſterlings*, deſigned for the preſervation of the foundation piles. Theſe contracted the ſpace between the piers ſo greatly, as to occaſion at the retreat of every tide a fall of five feet, or a number of temporary cataracts, which ſince the foundation of the bridge have occaſioned the loſs of many thouſand lives. The number of arches was 19, of unequal dimenſions, and greatly deformed by the ſterlings and the houſes on each ſide, which overhung and leaned in a moſt terrific name. In moſt places they hid the arches, and nothing appeared but the rude piers. Within recollection, frequent arches of ſtrong timber croſſed the ſtreet from the tops of the houſes to keep them together, and from falling into the river (A). Nothing but uſe could preſerve the quiet of the inmates, who ſoon grew deaf to the noiſe of the falling waters, the clamours of watermen, or the frequent ſhrieks of drowning wretches. In one part had been a drawbridge, uſeful either by way of

(A) The gallant action of Edmund Oſborne, anceſtor to the duke of Leeds, when he was apprentice to Sir William Hewet cloth-worker, may not improperly be mentioned in this place. About the year 1536, when his maſter lived in one of thoſe tremendous houſes, a ſervant maid was playing with his only daughter in her arms in a window over the water, and accidentally dropt the child. Young Oſborne, who was witneſs to the misfortune, inſtantly ſprang into the river, and beyond all expectation, brought her ſafe to the terrified family! Several perſons of rank paid their addreſſes to her when ſhe was marriageable, among others the earl of Shrewſbury; but Sir William gratefully decided in favour of Oſborne: *Oſborne*, ſays he, *ſaved her, and Oſborne ſhall enjoy her*. In her right he poſſeſſed a great fortune. He became ſheriff of London in 1575, and lord mayor in 1582.

London. of defence or for the admiſſion of ſhips into the upper part of the river. This was protected by a ſtrong tower. It ſerved to repulſe Falconbridge the Baſtard in his general aſſault on the city in 1471, with a ſet of banditti, under pretence of reſcuing the unfortunate Henry, then confined in the Tower. Sixty houſes were burnt on the bridge on the occaſion. It alſo ſerved to check, and in the end annihilate, the ill-conducted inſurrection of Sir Thomas Wyat, in the reign of Queen Mary. The top of this tower, in the ſad and turbulent days of this kingdom, uſed to be the ſhambles of human fleſh, and covered with heads or quarters of unfortunate partizans. Even ſo late as the year 1598, Hentzner, the German traveller, with German accuracy, counted on it above 30 heads. The old map of the city in 1597 repreſents them in a moſt horrible cluſter.—An unparalleled calamity happened on this bridge within four years after it was finiſhed. A fire began on it at the Southwark end; multitudes of people ruſhed out of London to extinguiſh it; while they were engaged in this charitable deſign, the fire ſeized on the oppoſite end, and hemmed in the crowd. Above 3000 perſons periſhed in the flames, or were drowned by overloading the veſſels which were hardy enough to attempt their relief.

The narrowneſs of the paſſage on this bridge having occaſioned the loſs of many lives from the number of carriages continually paſſing; and the ſtraitneſs of the arches, with the enormous ſize of the ſterlings, which occupied one-fourth part of the water-way, having alſo occaſioned frequent and fatal accidents, as already mentioned; the magiſtrates of London in 1756 obtained an act of parliament for improving and widening the paſſage over and through the bridge, which granted them a toll for every carriage and horſe paſſing over it, and for every veſſel with goods paſſing through it: but theſe tolls proving inſufficient, were aboliſhed by an act made in 1758 for explaining, amending, and rendering the former act more effectual; and for granting the city of London money towards carrying on that work. In conſequence of theſe acts of parliament, a temporary wooden bridge was built, and the houſes on the old bridge were taken down. Inſtead of a narrow ſtreet 23 feet wide, there is now a paſſage of 31 feet for carriages, with a raiſed pavement of ſtone on each ſide 7 feet broad for the uſe of foot paſſengers. The ſides are ſecured by ſtone baluſtrades, enlightened in the night with lamps. The paſſage through the bridge is enlarged by throwing the two middle arches into one, and by other alterations and improvements; notwithſtanding which, however, it is ſtill greatly ſubject to its former inconveniences.—Under the firſt, ſecond, and fourth arches, from the north ſide of the bridge, and now likewiſe towards the ſouthern extremities, there are engines worked by the flux and reflux of the river, the water of which they raiſe to ſuch a height as to ſupply many parts of the city. Thoſe engines were contrived in 1582 by one Peter Morice a Dutchman, and are called *London-bridge water-works*. By the report of a committee appointed to conſider of the requiſite improvements in and about London, it was propoſed to remove the preſent London bridge, and to replace it by one of caſt iron 65 feet high in the clear above high water. Part of the plan which came under the conſideration of the committee in 1801, was a deſign of Meſſrs. Telford and Douglas, London. in which it is propoſed to conſtruct the bridge of a ſingle arch, compoſed wholly of caſt iron; the ſpan of the arch is to be 600 feet, being the width to which, by Mr Jeſſop's report, the river ought to be contracted. The boldneſs and ſimplicity of this deſign render it an object of great attention, not only to the committee engaged in conſidering the further improvement of the port of London, but to the public. No progreſs, we believe, has yet been made in the execution of this plan.

Near the north ſide of London bridge ſtands the 46 The Monument. *Monument*, a beautiful and magnificent fluted column of the Doric order, built with Portland ſtone, and erected in memory of the conflagration 1666. It was begun by Sir Chriſtopher Wren in 1671, and finiſhed by him in 1677. Its height from the pavement is 202 feet; the diameter of the ſhaft, or body of the column, is 15 feet; the ground-plinth, or loweſt part of the pedeſtal, is 28 feet ſquare; and the pedeſtal is 40 feet high. Over the capital is an iron balcony encompaſſing a cone 32 feet high, which ſupports a blazing urn of gilt braſs. Within is a large ſtaircaſe of black marble, containing 345 ſteps, each 10 inches and a half broad, and ſix inches thick. The weſt ſide is adorned with a curious emblem in alt-relief, denoting the deſtruction and reſtoration of the city. The firſt female figure repreſents London ſitting in ruins, in a languiſhing poſture, with her head dejected, her hair diſhevelled, and her hand careleſsly lying on her ſword. Behind is *Time*, gradually raiſing her up: at her ſide is a woman touching her with one hand, whilſt a winged ſceptre in the other directs her to regard the goddeſſes in the clouds; one with a cornucopia, denoting *Plenty*; the other with a palm branch, the emblem of *Peace*. At her feet is a bee hive, ſhowing, that by induſtry and application the greateſt misfortunes are to be overcome. Behind the figure of *Time* are citizens exulting at his endeavours to reſtore her; and beneath, in the midſt of the ruins, is a dragon, who, as the ſupporter of the city arms, with his paw endeavours to preſerve the ſame. Oppoſite to the city, on an elevated pavement, ſtands the king, in a Roman habit, with a laurel on his head, and a truncheon in his hand; and approaching her, commands three of his attendants to deſcend to her relief. The firſt repreſents the *Sciences* with a winged head and circle of naked boys dancing thereon; and holding *Nature* in her hand, with her numerous breaſts, ready to give aſſiſtance to all. The ſecond is *Architecture*, with a plan in one hand, and ſquare and a pair of compaſſes in the other; and the third is *Liberty*, waving a hat in the air, ſhowing her joy at the pleaſing proſpect of the city's ſpeedy recovery. Behind the king ſtands his brother the duke of York, with a garland in one hand to crown the riſing city, and a ſword in the other for her defence. The two figures behind are *Juſtice* and *Fortitude*; the former with a coronet, and the latter with a reined lion; and under the royal pavement lies *Envy*, gnawing a heart, and inceſſantly emitting peſtiferous fumes from her month. On the plinth the reconſtruction of the city is repreſented by builders and labourers at work upon houſes. On the north, ſouth, and eaſt ſides, are inſcriptions relating to the deſtruction occaſioned by the conflagration, the regulations about rebuilding the city, and erecting the monument;

and

London. and round it is the following one:—"This pillar was ſet up in perpetual remembrance of the moſt dreadful burning of this Proteſtant city, begun and carried on by the treachery and malice of the Popiſh faction, in the beginning of September, in the year of our Lord 1666, in order to their carrying on their horrid plot for extirpating the Proteſtant religion and *old Engliſh* liberty, and introducing Popery and ſlavery." Dr Wendeborn, in his account of London, obſerves, that the monument, though not much above 100 years old, bears viſible marks of decay already; and it will not probably be long before it muſt be pulled down. Some are of opinion that this is occaſioned by the fault of the architect, others by the continual ſhaking of the ground by coaches; but the doctor inclines to the latter opinion.

47 The Tower. Eaſtward of the bridge and monument ſtands the *Tower*, which gives name to another ward. It is the chief fortreſs of the city, and ſuppoſed to have been originally built by William the Conqueror. It appears, however, to have been raiſed upon the remains of a more ancient fortreſs, erected probably by the Romans: for in 1720, in digging on the ſouth ſide of what is called *Cæſar's Chapel*, there were diſcovered ſome old foundations of ſtone, three yards broad, and ſo ſtrongly cemented that it was with the utmoſt difficulty they were forced up. The firſt work (according to Mr Pennant) ſeems to have been ſuddenly flung up in 1066 by the Conqueror, on his taking poſſeſſion of the capital; and included in it a part of the ancient wall.

The great ſquare tower, called the *White Tower*, was erected in the year 1078, when it aroſe under the directions of Gundulph biſhop of Rocheſter, who was a great military architect. This building originally ſtood by itſelf. Fitz-Stephen gives it the name of *Arx Palatina*, "the Palatine Tower;" the commander of which had the title of Palatine beſtowed on him. Within this tower is a very ancient chapel for the uſe of ſuch of our kings and queens who wiſhed to pay their devotion here. In 1092 a violent tempeſt did great injury to the Tower; but it was repaired by William Rufus and his ſucceſſor. The firſt added another caſtellated building on the ſouth ſide between it and the Thames, which was afterwards called *St Thomas's Tower*.

The Tower was firſt encloſed by William Longchamp biſhop of Ely and chancellor of England, in the reign of Richard I. This haughty prelate having a quarrel with John, third brother to Richard, under pretence of guarding againſt his deſigns, ſurrounded the whole with walls embattled, and made on the outſide a vaſt ditch, into which, in after times, the water from the Thames was introduced. Different princes added other works. The preſent contents within the walls are 12 acres and 5 rods, the circuit on the outſide of the ditch 1052 feet. It was again encloſed with a mud wall, by Henry III.: this was placed at a diſtance from the ditch, and occaſioned the taking down part of the city-wall, which was reſented by the citizens; who, pulling down this precinct of mud, were puniſhed by the king with a fine of a thouſand merks.

The *Lions Tower* was built by Edward IV. It was originally called the *Bulwark*, but received the former name from its uſe. A menagery had very long been a piece of regal ſtate: Henry I. had his at his manor of Woodſtock, where he kept lions, leopards, lynxes, porcupines, and ſeveral other uncommon beaſts. They were afterwards removed to the Tower. Edward II. commanded the ſheriffs of London to pay the keepers of the king's leopards ſixpence a-day for the ſuſtenance of the leopards, and three halfpence a-day for the diet of the keeper out of the fee-farm of the city. The royal menagery is to this day exceedingly well ſupplied.

In 1758 the Tower ditch was railed all round. New barracks were ſome years ago erected on the Tower wharf, which parts it from the river; and upon the wharf is a line of 61 pieces of cannon, which are fired upon ſtate holidays. On this ſide of the Tower the ditch is narrow, and over it is a drawbridge. Parallel to the wharf, within the walls, is a platform 70 yards in length, called the *Ladies Line*, becauſe much frequented by the ladies in the ſummer; it being ſhaded in the inſide with a row of lofty treees, and without is a delightful proſpect of the ſhipping with boats paſſing and repaſſing on the river Thames. You aſcend this line by ſtone ſteps, and being once upon it you may walk almoſt round the walls of the Tower without interruption.

The principal entrance into the Tower is by a gate to the weſt, large enough to admit coaches and heavy carriages; but theſe are firſt admitted through an outward gate, ſituated without the ditch upon the hill, and muſt paſs a ſtout ſtone bridge built over the ditch before they can approach the main entrance. There is, beſides, an entrance near the very ſouth-weſt corner of the Tower outward wall, for perſons on foot, over the drawbridge already mentioned to the wharf. There is alſo a water-gate, commonly called *Traitor's gate*, through which it has been cuſtomary to convey traitors and other ſtate priſoners to or from the Tower, and which is ſeldom opened on any other occaſion; but the lords committed to the Tower in 1746 were publicly admitted at the main entrance. Over this gate is a regular building, terminated at each end by two round towers, on which are embraſures for pointing cannon. In this building there are the infirmary, the mill, and the water-works that ſupply the Tower with water.

In the Tower, the curioſities of which are more particularly deſcribed in the note (B), are a church, the offices of ordnance and of the mint, thoſe of the keepers

(B) In examining the curioſities of the Tower of London, it will be proper to begin with thoſe on the outſide of the principal gate. The firſt thing a ſtranger uſually goes to viſit is the wild beaſts; which, from their ſituation, firſt preſent themſelves: for having entered the outer gate, and paſſed what is called the ſpur-guard, the keeper's houſe preſents itſelf before you, which is known by a painted lion on the wall, and another over

London. keepers of the records, of the jewel office, of the Spaniſh armoury, the horſe armoury, and the new or ſmall armoury; with barracks for the ſoldiers of the garriſon, and handſome houſes for ſeveral officers who reſide here. The principal officers of the Tower are, a conſtable, a lieutenant, and a deputy-lieutenant. Belonging to this fortreſs are 11 hamlets; the militia of which, conſiſting of 400 men, are obliged, at the command of the conſtable of the Tower, to repair hither, and reinforce the garriſon.

On Little Tower-hill is the *Victualling office* for the navy. It is ſeparated from Towerhill by a wall and gate, and contains houſes for the officers, ſlaughter-houſes, ſtorerooms, a brewhouſe, a ſalting-houſe, and barrelling-houſe; under the direction of ſeven commiſſioners and other inferior officers. 48 Victualling Office.

In

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over the door which leads to their dens. By ringing a bell, and paying ſixpence each perſon, you may eaſily gain admittance.

The next place worthy of obſervation is the Mint, which comprehends near one-third of the Tower, and contains houſes for all the officers belonging to the coinage. On paſſing the principal gate you ſee the White Tower, built by William the Conqueror. This is a large, ſquare, irregular ſtone building, ſituated almoſt in the centre, no one ſide anſwering to another, nor any of its watch-towers, of which there are four at the top, built alike. One of theſe towers is now converted into an obſervatory. In the firſt ſtory are two noble rooms, one of which is a ſmall armoury for the ſea-ſervice, it having various ſorts of arms, very curiouſly laid up, for above 10,000 ſeamen. In the other room are many cloſets and preſſes, all filled with warlike engines and inſtruments of death. Over this are two other floors, one principally filled with arms; the other with arms and other warlike inſtruments, as ſpades, ſhovels, pickaxes, and chevaux de frize. In the upper ſtory are kept match, ſheep-ſkins, tanned hides, &c. and in a little room called Julius Cæſar's chapel, are depoſited ſome records, containing perhaps the ancient uſages and cuſtoms of the place. In this building are alſo preſerved the models of the new-invented engines of deſtruction that have from time to time been preſented to the government. Near the ſouth-weſt angle of the White Tower is the Spaniſh armoury, in which are depoſited the ſpoils of what was vainly called the Invincible Armada; in order to perpetuate to lateſt poſterity the memory of that ſignal victory obtained by the Engliſh over the whole naval power of Spain in the reign of Philip II.

You are now come to the grand ſtorehouſe, a noble building to the northward of the White Tower, that extends 245 feet in length and 60 in breadth. It was begun by King James II. who built it to the firſt floor; but it was finiſhed by King William III. who erected that magnificent room called the New or Small Armoury, in which that prince, with Queen Mary his conſort, dined in great form, having all the warrant workmen and labourers to attend them, dreſſed in white gloves and aprons, the uſual badges of the order of maſonry. To this noble room you are led by a folding door, adjoining to the eaſt end of the Tower chapel, which leads to a grand ſtaircaſe of 50 eaſy ſteps. On the left ſide of the uppermoſt landing-place is the work-ſhop, in which are conſtantly employed about 14 furbiſhers, in cleaning, repairing, and new-placing the arms. On entering the armoury, you ſee what they call a wilderneſs of arms, ſo artfully diſpoſed, that at one view you behold arms for near 80,000 men, all bright and fit for ſervice; a ſight which it is impoſſible to behold without aſtoniſhment; and beſide thoſe expoſed to view, there were, before the late war, 16 cheſts ſhut up, each cheſt holding about 1000 muſkets. The arms were originally diſpoſed by Mr Harris, who contrived to place them in this beautiful order, both here and in the guard-chamber of Hampton-court. He was a common gunſmith; but after he had performed this work, which is the admiration of people of all nations, he was allowed a penſion from the crown for his ingenuity.

Upon the ground floor, under the ſmall armoury, is a large room of equal dimenſions with that, ſupported by 20 pillars, all hung round with implements of war. This room, which is 24 feet high, has a paſſage in the middle 16 feet wide. At the ſight of ſuch a variety of the moſt dreadful engines of deſtruction, before whoſe thunder the moſt ſuperb edifices, the nobleſt works of art, and numbers of the human ſpecies, fall together in one common and undiſtinguiſhed ruin; one cannot help wiſhing that thoſe horrible inventions had ſtill lain, like a falſe conception, in the womb of nature, never to have been ripened into birth.

The horſe armoury is a plain brick building, a little to the eaſtward of the White Tower; and is an edifice rather convenient than elegant, where the ſpectator is entertained with a repreſentation of thoſe kings and heroes of our own nation, with whoſe gallant actions it is to be ſuppoſed he is well acquainted; ſome of them equipped and ſitting on horſeback, in the ſame bright and ſhining armour they were uſed to wear when they performed thoſe glorious actions which gave them a diſtinguiſhed place in the Britiſh annals.

You now come to the line of kings, which your conductor begins by reverſing the order of chronology; ſo that in following them we muſt place the laſt firſt.

In a dark, ſtrong ſtone room, about 20 yards to the eaſtward of the grand ſtorehouſe, or new armoury, the crown jewels are depoſited. 1. The imperial crown, with which it is pretended that all the kings of England have been crowned ſince Edward the Confeſſor in 1040. It is of gold, enriched with diamonds, rubies, emeralds, ſapphires, and pearls: the cap within is of purple velvet, lined with white taffety, turned up with three rows of ermine. They are, however, miſtaken in ſhowing this as the ancient imperial diadem of St Edward; for that, with the other moſt ancient regalia of this kingdom, was kept in the arched room in the cloiſters in Weſtminſter Abbey till the civil war: when, in 1642, Harry Martin, by order of the parliament, broke open the iron cheſt in which it was ſecured, took it thence, and ſold it, together with the

 robes,

London.

49 Customhouse. In Tower ward is also the *Customhouse*, a large, handsome, and commodious building of brick and stone. It stands upon the bank of the Thames, and is accommodated with large wharfs, keys, and warehouses. On this spot is the busy concourse of all nations, who pay their tribute towards the support of Great Britain. About the year 1559, the loss to the revenue, by collecting it in different parts of the city, was first discovered, and an act passed to compel people to land their goods in such places as were appointed by the commissioners of the revenue; and this was the spot fixed on: A customhouse was erected; which, being destroyed by the great fire, was rebuilt by Charles II. In 1718 it underwent the same fate, and was restored in its present form. Before the customhouse was established here, the principal place for receiving the duties was at Billingsgate. In 1268 the half year's customs for foreign merchandise in the city of London came

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robes, sword, and sceptre, of St Edward. However, after the Restoration, King Charles II. had one made in imitation of it, which is that now shown. 2. The golden orb, or globe, put into the king's right hand before he is crowned: and borne in his left hand, with the sceptre in his right, upon his return into Westminster-hall after he is crowned. It is about six inches in diameter, edged with pearl, and enriched with precious stones. On the top is an amethyst, of a violet colour, near an inch and a half in height, set with a rich cross of gold, adorned with diamonds, pearls, and precious stones. The whole height of the ball and cup is 11 inches. 3. The golden sceptre, with its cross set upon a large amethyst of great value, garnished round with table diamonds. The handle of the sceptre is plain, but the pummel is set round with rubies, emeralds, and small diamonds. The top rises into a *fleur de lis* of six leaves, all enriched with precious stones, from whence issues a mound or ball, made of the amethyst already mentioned. The cross is quite covered with precious stones. 4. The sceptre, with the dove, the emblem of peace, perched on the top of a small Jerusalem cross, finely ornamented with table diamonds and jewels of great value. This emblem was first used by Edward the Confessor, as appears by his seal; but the ancient sceptre and dove was sold with the rest of the regalia, and this now in the Tower was made after the Restoration. 5. St Edward's staff, four feet seven inches and a half in length, and three inches three quarters in circumference, all of beaten gold, which is carried before the king at his coronation. 6. The rich crown of state, worn by his majesty in parliament; in which is a large emerald seven inches round; a pearl esteemed the finest in the world; and a ruby of inestimable value. 7. The crown belonging to his royal highness the prince of Wales. The king wears his crown on his head when he sits upon the throne; but that of the prince of Wales is placed before him, to show that he is not yet come to it. 8. The late Queen Mary's crown, globe, and sceptre, with the diadem she wore at her coronation with her consort King William III. 9. An ivory sceptre, with a dove on the top, made for King James II.'s queen, whose garniture is gold, and the dove on the top gold enamelled with white. 10. The *curtana*, or sword of mercy, which has a blade of 32 inches long, and near two broad, is without a point, and is borne naked before the king at his coronation, between the two swords of justice, spiritual and temporal. 11. The golden spurs, and the armillas, which are bracelets for the wrists. These, though very antique, are worn at the coronation. 12. The *ampulla*, or eagle of gold, finely engraved, which holds the holy oil the kings and queens of England are anointed with; and the golden spoon that the bishop pours the oil into. These are two pieces of great antiquity. The golden eagle, including the pedestal, is about nine inches high, and the wings expand about seven inches. The whole weighs about ten ounces. The head of the eagle screws off about the middle of the neck, which is made hollow for holding the holy oil; and when the king is anointed by the bishop, the oil is poured into the spoon out of the bird's bill. 13. A rich saltseller of state, in form like the square White Tower, and so exquisitely wrought, that the workmanship of modern times is in no degree equal to it. It is of gold, and used only on the king's table at the coronation. 14. A noble silver font, double gilt, and elegantly wrought, in which the royal family are christened. 15. A large silver fountain presented to King Charles II. by the town of Plymouth, very curiously wrought; but much inferior in beauty to the above. Besides these, which are commonly shown, there are in the jewel office all the crown jewels worn by the princes and princesses at coronations, and a great variety of curious old plate.

The record office consists of three rooms, one above another, and a large round room, where the rolls are kept. These are all handsomely wainscotted, the wainscot being framed into presses round each room, within which are shelves and repositories for the records; and for the easier finding of them, the year of each reign is inscribed on the inside of these presses, and the records placed accordingly. Within these presses, which amount to 56 in number, are deposited all the rolls, from the first year of the reign of King John to the beginning of the reign of Richard III. but those after this last period are kept in the Rolls Chapel. The records in the Tower, among other things, contain the foundation of abbeys and other religious houses; the ancient tenures of all the lands in England, with a survey of the manors; the original of laws and statutes; proceedings of the courts of common law and equity; the rights of England to the dominion of the British seas; leagues and treaties with foreign princes: the achievements of England in foreign wars; the settlement of Ireland, as to law and dominion; the forms of submission of some Scottish kings for territories held in England; ancient grants of our kings to their subjects; privileges and immunities granted to cities and corporations during the period above mentioned; enrolments of charters and deeds made before the conquest; the bounds of all the forests in England, with the several respective rights of the inhabitants to common pasture, and many other important records, all regularly disposed, and referred to in near a thousand folio indexes. This office is kept open, and attendance constantly given, from seven o'clock till one, except in the months of December, January, and February, when it is open only from eight to one, Sundays and holidays excepted. A search here is half a guinea, for which you may peruse any one subject a year.

London.

came only to 75l. 6s. 10d.; the annual produce of the customs, ending in April 1789, amounted to 3,711,126l.

50 Trinity House.

In Water-lane, a little to the north-west of the customhouse, is the *Trinity House;* a society founded in 1515, at a period in which the Brititish navy began to assume a system. The founder was Sir Thomas Spert, comptroller of the navy, and commander of the great ship Henry Grace de Dieu. It is a corporation, consisting of a master, four wardens, eight assistants, and eighteen elder brethren; selected from commanders in the navy and the merchants service; and now and then a compliment is paid to one or two of our first nobility. They may be considered as guardians of our ships, military and commercial. Their powers are very extensive: they examine the mathematicial children of Christ's hospital, and the masters of his majesty's ships; they appoint pilots for the river Thames; settle the general rates of pilotage; erect light houses and sea marks; grant licenses to poor seamen, not free of the city, to row on the Thames; prevent foreigners from serving on board our ships without license; punish seamen for mutiny and desertion; hear and determine complaints of officers and men in the merchants service, but liable to appeal to the judge of the court of admiralty; superintend the deepening and cleansing of the river Thames, and have under their jurisdiction the ballast office; have powers to buy lands, and receive donations for charitable uses; and in consequence, relieve annually many thousands of poor seamen, their widows, and orphans. It is in this house the business of the institution is carried on: but the mother house is at Deptford, the corporation being named, "the master, wardens, and assistants of the guild or fraternity of the most glorious and undivided Trinity, and of St Clement, in the parish of Deptford Strond, in the county of Kent."

51 The Minories.

Between Aldgate and the Tower is the street called the *Minories*, from some poor ladies of the order of St Clare, or minoresses. They had been invited to London by Blanch queen of Navarre, and wife to Edmund earl of Lancaster, who founded a convent for them in 1293. On the suppression of the monasteries it was converted into a dwelling house for some of the nobility, and is now in the possession of the Dartmouth family. Till of late years, the Minories were but a despicable street; but have now been excellently rebuilt, and are as elegant as any in the city.

On the west side of the city walls at this place, stood the house of the *Crutched* or *Crossed Friars*, an order instituted at Bologna in 1169, and of which a branch settled in England in 1244, where they were accommodated with a house in this place by two citizens named *Ralph Hosier* and *William Sabernas*, who became members of their order. Henry VIII. granted their house to Sir Thomas Wyat the elder, who built a handsome mansion on part of the ground where it stood. This mansion became afterwards the residence of John Lord Lumley, a celebrated warrior in the time of Henry VIII. In process of time, it was converted into a navy office: but this office being removed to Somerset-house, the India Company have erected in its place a most magnificent warehouse, in form of an oblong square of about 250 feet by 160, enclosing a court of 150 by 60 feet, the entrance to which is by an arched gateway.

52 India Company's warehouses.

53 Billingsgate.

Billingsgate ward is distinguished by its *market*. *Billingsgate* was a small port for the reception of shipping, and for a considerable time the most important place for the landing of almost every article of commerce. In the time of King William, Billingsgate began to be celebrated as a fish-market. In 1699 it was by act of parliament made a free port for fish to be sold there every day except Sunday; but Mr Pennant informs us, that the object of this has long been frustrated, and that fish are now no longer to be had there in perfection. The same author gives a list of the fish which in the time of Edward III. were brought to the London market; the monarch himself having condescended to regulate the prices, that his subjects might not be imposed upon by those who sold them. Among these were the conger-eel and porpoise, neither of which is now admitted to any table. A pike at that time cost 6s. 8d.; whence our author concludes, that it was an exotic fish, and brought over at a vast expence. Some fishes are mentioned in his list with which this naturalist owns himself unacquainted, viz. the *barkey*, *bran*, *batrile*, *cropling*, and *rumb*. In Archbishop Nevill's great feast is mentioned also a fish named *thirle-poole*, unknown at present. Seals were formerly accounted a fish; and these, together with the sturgeon and porpoise, were the only fresh fish permitted by the 33d of Henry VIII. to be bought of any stranger at sea between England, France, Flanders, and Zealand.

54 Leadenhall.

Limestreet ward is remarkable for a very large building of great antiquity, called *Leadenhall*, with flat battlements leaded on the top, and a spacious square in the middle. In 1309 it was the house of Sir Hugh Nevill, knight; in 1384, of Humphry Bohun earl of Hereford; in 1408 it became the property of the celebrated Whittington, who presented it to the mayor and commonalty of London; and in 1419, a public granary was erected here by Sir Simon Eyre, a citizen and draper, who built it with stone in its present form. This granary was designed as a preservative against famine, and to be kept always full of corn, which design was for some time happily answered. The house came to be used for many other purposes besides that of a granary; as for keeping the artillery and arms of the city. Preparations for any kind of pageantry or triumph were also made here; and from its strength the place was considered as the chief fortress within the city in case of any popular insurrection, and was likewise the place from whence alms were distributed. In this edifice are warehouses for the sale of leather, Colchester baize, meal, and wool. Adjoining to Leadenhall is a market, thence called *Leadenhall market*, consisting of five considerable squares or courts, and reckoned one of the greatest markets in Europe for flesh and other provisions, as well as for leather, green hides, and wool. A little to the eastward is the *India House*, built in 1726, on the spot occupied by Sir William Craven, mayor in 1610. According to Mr Pennant, this house "is not worthy of the lords of Indostan."

55 The India-House.

56 Bank of England.

In Broad-street is the *Bank of England*, a stone building, which occupies one side of Threadneedle-street. The centre, and the building behind, were founded in in the year 1733; the architect George Sampſon. Before that time the buſineſs was tranſacted in Grocers-hall. The front is a ſort of veſtibule; the baſe ruſtic, the ornamental columns above Ionic. Within is a court leading to a ſecond elegant building, which contains a hall and offices, where the debt of above 250 millions is punctually diſcharged. Of late years two wings of uncommon elegance, deſigned by Sir Robert Taylor, have been added, at the expence of a few houſes, and of the church of St Chriſtopher's le Stocks. "The name of the projector of this national glory (ſays Mr Pennant), was Mr James Paterſon of Scotland. This palladium of our country was in 1780 ſaved from the fury of an infamous banditti by the virtue of its citizens, who formed ſuddenly a volunteer company, and overawed the miſcreants; while the chief magiſtrate ſkulked trembling in his manſion-houſe, and left his important charge to its fate. This important building has ever ſince been very properly guarded by the military; who, in paſſing through the city, have often given offence to many buſy characters who would ſtrive to preſerve the city rights at the expence of the national deſtruction. A lord mayor was the laſt who intereſted himſelf by applying to Mr Grenville, who gave him to underſtand, that if the guards were not quietly permitted to diſcharge their duty, the bank would be removed to Somerſet-houſe."

57 Merchant-Taylors Hall, &c.

At the extremity of Threadneedle-ſtreet is *Merchant-Taylors Hall*. In this ſtreet alſo is the *South Sea Houſe*, firſt eſtabliſhed in 1711 for the purpoſe of an excluſive trade to the South ſea, and for ſupplying Spaniſh America with negroes.

Near the junction of Throgmorton-ſtreet with Broad-ſtreet ſtood a magnificent houſe built by Cromwell earl of Eſſex; after whoſe fall, the houſe and gardens were bought by the Drapers company. The houſe was deſtroyed in the great fire, but rebuilt for the uſe of the company in a magnificent manner.

58 St Giles's.

Mr Pennant informs us, that *St Giles's church* in the fields, and a few houſes to the weſt of it, in the year 1600, were barely ſeparated from Broad-ſtreet. The church is ſuppoſed to have belonged to an hoſpital for lepers, founded about the year 1117, by Matilda queen to Henry I. In ancient times it was cuſtomary here to preſent to malefactors, on their way to the gallows (which, about the year 1413, was removed from Smithfield, and placed between St Giles's high-ſtreet and Hog lane (c), a great bowl of ale, as the laſt refreſhment they were to receive in this life. On the door to the churchyard is a curious piece of ſculpture, repreſenting the laſt day, containing an amazing number of figures, ſet up about the year 1686. This church was rebuilt in 1625. By the amazing raiſing of the ground by filth and various adventitious matter, the floor in the year 1730 was eight feet below the ſurface acquired in the intervening time. This alone made it neceſſary to rebuild the church in the preſent century. The firſt ſtone was laid in 1730; it was finiſhed in 1734, at the expence of 10,000l.—In the churchyard is a great ſquare pit, with many rows of coffins piled one upon the other, all expoſed to ſight and ſmell, the latter of which is highly offenſive if not dangerous.

On the weſt ſide of Broad-ſtreet ſtood the houſe of the Auguſtines, founded by Humphrey Bohun earl of Somerſet in 1253, for friars and hermits of the Auguſtine order. On the diſſolution of the monaſteries, great part of the houſe was granted to William Lord St John, afterwards marquis of Wincheſter, and lord treaſurer, who founded a magnificent houſe named *Wincheſter-houſe*. The weſt end of the church was granted in 1551 to John à Laſco for the uſe of the Germans and other fugitive Proteſtants, and afterwards to the Dutch as a place for preaching. A part of it was alſo converted into a glaſs-houſe for Venice glaſs, in which the manufacture was carried on by artiſts from that city, and patroniſed by the duke of Buckingham. The place was afterwards converted into *Pinners-hall*, belonging to the company of pinmakers.

59 Wincheſter Houſe.

To the eaſtward of Wincheſter-ſtreet ſtood the houſe of that very eminent merchant Sir Thomas Greſham, afterwards known by the name of *Greſham college*: (See GRESHAM.) It has been pulled down not many years ago; and the *Exciſe Office*, a moſt magnificent and at the ſame time ſimple building, roſe in its place. Mr Pennant informs us, that from the 5th of January 1786 to January 5th 1787, the payments into this office amounted to no leſs than 5,531,114l. 6s. 10½d.

60 Greſham College.

61 Exciſe Office.

62 Royal Exchange.

The *Royal Exchange*, which is the meeting place of the merchants of London, ſtands in the ward of Cornhill, and is the fineſt and ſtrongeſt fabric of the kind in Europe. It was founded in the year 1566. Sir Thomas Greſham merchant in London, made an offer to the lord mayor and citizens, to build, at his own expence, a commodious edifice for merchants to meet and tranſact buſineſs, provided the city would find him a convenient ſituation for the ſame. Mr Pennant informs us, that one Richard Clough a Welſhman, originally Sir Thomas's ſervant, firſt put him on this deſign by a letter from Antwerp, in which he reproached the London merchants with having no place to tranſact their buſineſs, but walking about in the rain, more like pedlars than merchants. The citizens, in compliance with Sir Thomas's deſire, purchaſed,

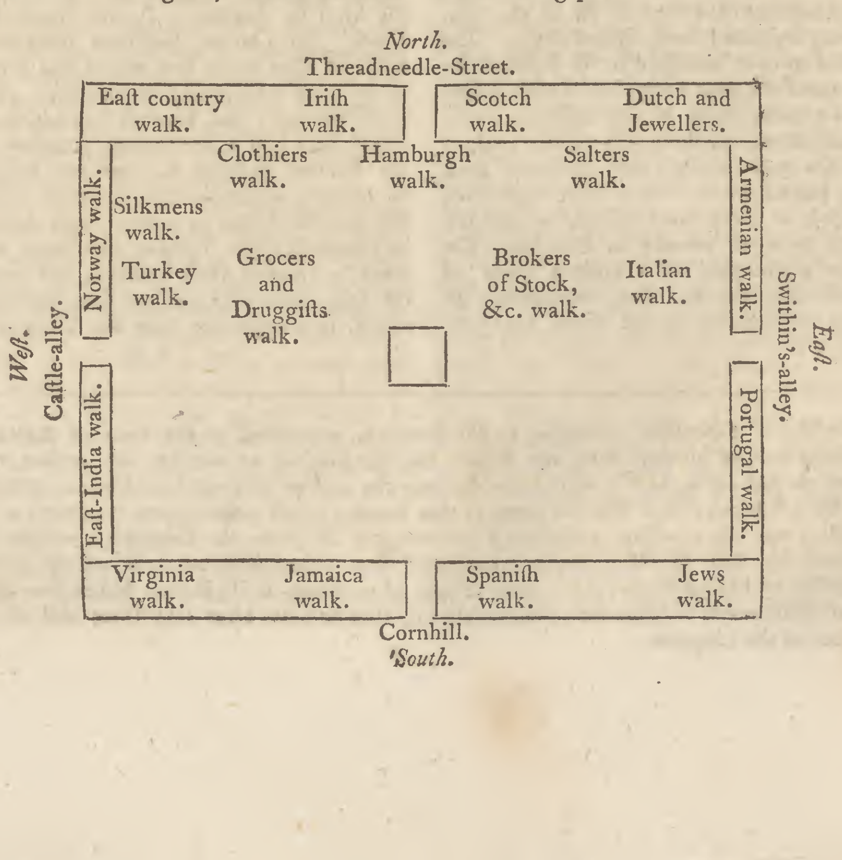
(c) This late place of execution, according to Mr Pennant, was called in the time of Edward III. when the gentle Mortimer finiſhed his days here, *the Elms*: but the original as well as the preſent name was *Tyburne*; not from *tye* and *burn*, as if it were called ſo from the manner of capital puniſhments; but from *bourne*, the Saxon word for a "brook," and *Tye* the name of that brook, which joined gave name to a manor before the conqueſt. Here was alſo a village and church denominated *St John the Evangeliſt*, which fell to decay, and was ſucceeded by that of *Mary-bourne*, corrupted into *Mary la-bonne*. In 1626, Queen Henrietta Maria was compelled by her prieſts to take a walk by way of penance to Tyburn. What her offence was we are not told; but Charles was ſo diſguſted at this inſolence, that he ſoon after ſent them and all her majeſty's French ſervants out of the kingdom.

London.

chaſed, for the ſum of 3532l. 80 houſes in the two alleys called *New St Chriſtopher's* and *Swan-alley*, leading out of Cornhill into Threadneedle-ſtreet. The materials of thoſe houſes were ſold for 478l. and the ground, when cleared, was conveyed to Sir Thomas Greſham, who, accompanied by ſeveral aldermen, laid the firſt brick of the new building on the 7th of June that year. Each alderman alſo laid his brick, and left a piece of gold for the workmen; who ſet about it with ſuch aſſiduity and reſolution, that the whole fabric was roofed by the month of November 1567, and was ſoon after completed under the name of the *Burſe*. This building was totally deſtroyed by the fire in 1666; and in its place the preſent magnificent ſtructure was erected at the expence of 80,000l. which ſtands upon a plat of ground 203 feet in length and 171 in breath, containing an area in the middle, of 61 ſquare perches, ſurrounded with a ſubſtantial and regular ſtone building, wrought in ruſtic. It has two fronts, north and ſouth, each of which is a piazza; and in the centre are the grand entrances into the area, under a very lofty and noble arch. The ſouth front in Cornhill is the principal; on each ſide of which are Corinthian demi-columns, ſupporting a compaſs pediment; and, in the intercolumniation on each ſide, in the front next the ſtreet, is a niche, with the ſtatues of King Charles I. and II. in Roman habits, and well executed. Over the aperture, on the cornice between the two pediments, are the king's arms in relievo; on each ſide of this entrance is a range of windows placed between demi-columns and pilaſters of the compoſite order, above which runs a baluſtrade. This building is 56 feet high; and from the centre, in this front, riſes a lanthorn and turret 178 feet high, on the top of which is a vane of gilt braſs made in the ſhape of a graſhopper, the creſt of Sir Thomas Greſham's arms. The north front in Threadneedle-ſtreet is adorned with pilaſters of the compoſite order; but has neither columns nor ſtatues on the outſide; and has triangular, inſtead of compaſs, pediments. The inſide of the area is alſo ſurrounded with piazzas, forming ambulatories for merchants, &c. to ſhelter themſelves from the weather, when met there upon buſineſs. Above the arches of this piazza is an entablature with curious ornaments: and on the cornice a range of pilaſters with an entablature extending round, and a compaſs pediment in the middle of the cornice of each of the four ſides. Under the pediment on the north ſide are the king's arms; on the ſouth, the city's arms; on the eaſt, Sir Thomas Greſham's arms; and on the weſt, the mercers arms, with their reſpective enrichments. In theſe intercolumns are 24 niches, 20 of which are filled with the ſtatues of the kings and queens of England. Under theſe piazzas, within the area, are 28 niches, all vacant but that in which Sir Thomas Greſham's ſtatue is placed in the north-weſt angle, and that in the ſouth-weſt, where the ſtatue of Sir John Barnard was placed in his lifetime by his fellow-citizens to expreſs their ſenſe of his merit. The centre of this area alſo is ornamented with a ſtatue of King Charles II. in a Roman habit, ſtanding upon a marble pedeſtal about eight feet high, and encompaſſed with iron rails; which pedeſtal is enriched on the ſouth ſide with an imperial crown, a ſceptre, ſword, palm-branches, and other decorations, with a very flattering inſcription to the king. On the weſt ſide is a Cupid cut in relievo, reſting his right hand on a ſhield, with the arms of France and England quartered, and holding a roſe in his left hand. On the north ſide is another Cupid ſupporting a ſhield, with the arms of Ireland; and on the eaſt ſide are the arms of Scotland, with a Cupid holding a thiſtle; all done in relievo: the whole executed by that able ſtatuary Mr Gibbon.

London.

In this area, merchants, and ſuch as have buſineſs with them, meet every day at change hours; and for the more regular and readier deſpatch of buſineſs, they diſpoſe of themſelves into ſeparate walks, according to the following plan.



In

London.

In building this expenſive ſtructure there was an eye not only to magnificence, and to accommodate the merchants, but alſo to reimburſe the expence. For this reaſon a gallery was built over the four ſides of the Royal Exchange. This was divided into 200 ſhops, which were let out to haberdaſhers, milliners, &c. and which for ſeveral years were well occupied. But theſe ſhops have now for a long time been deſerted, and the galleries are let out to the Royal Exchange Aſſurance-Office, the Merchant-ſeamen's Office, the Marine Society, and to auctioneers, &c. Under the whole area there are the fineſt dry vaults that can be found anywhere, which are let out to the Eaſt-India Company to depoſite their pepper. In the turret is a good clock with four dials, which is well regulated every day, ſo that it becomes a ſtandard of time to all the mercantile part of the town; and it goes with chimes at three, ſix, nine, and twelve o'clock, playing upon twelve bells. The outſide of this grand fabric ſuffers very much in its elegance from the ſhops that ſurround it, and are built within its walls; and which are occupied by bookſellers, toymen, cutlers, hoſiers, watchmakers, &c.

63 General Poſt Office. South of the Royal Exchange, and near the weſt extremity of Lombard-ſtreet, is the *General Poſt Office*, which is a handſome and commodious building.

64 The Manſion-houſe. In Walbrook ward is the *Manſion-houſe*, for the reſidence of the lord mayor. This edifice was begun in 1739, and finiſhed in 1753. It is built of Portland ſtone, with a portico of ſix fluted columns, of the Corinthian order, in the front. The baſement ſtory is very maſſy, and conſiſts of ruſtic work; in the centre of it is the door, which leads to the kitchen, cellars, and other offices. On each ſide riſes a flight of ſteps, leading up to the portico, in the middle of which is the principal entry. The ſtone baluſtrade of the ſtairs is continued along the front of the portico, and the columns ſupport a large angular pediment, adorned with a group of figures in bas relief, repreſenting the dignity and opulence of the city of London. It is an extremely heavy building, of an oblong form, and its depth is the long ſide, having ſeveral magnificent apartments, which are not, however, well lighted, on account of the houſes that ſurround it.

65 St Stephen's Church. Behind the Manſion-houſe is *St Stephen's Church*, in Walbrook, juſtly reputed the maſterpiece of the celebrated Sir Chriſtopher Wren, and is ſaid to exceed every modern ſtructure in the world in proportion and elegance.

The Manſion-houſe, and many adjacent buildings, ſtand on the place where the *Stocks-market* once ſtood. This took its name from a pair of ſtocks erected near the ſpot in 1281; and was the great market of London for proviſions during many centuries.

66 London-ſtone. In this ward is ſituated one of the moſt remarkable pieces of antiquity in London. It is a great ſtone, now ſtanding in a caſe on the north ſide of Canon-ſtreet, cloſe under the ſouth wall of St Swithin's church. It is called *London-ſtone;* and was formerly pitched edgeways on the other ſide of the ſtreet, oppoſite to where it now ſtands, fixed deeply in the ground, and ſtrongly faſtened with iron bars; but for the conveniency of wheel-carriages it was removed to its preſent ſituation. This ſtone is mentioned ſo early as the time of Athelſtan, king of the Weſt Saxons, and has been carefully preſerved from age to age. Of the original cauſe of its erection no memorial remains; but it is conjectured, that as London was a Roman city, this ſtone might be the centre, and might ſerve as an object from which the diſtance was computed to the other conſiderable cities or ſtations in the province.

67 Merchant-Taylors School. In Dowgate ward is a noted academy, called *Merchant-Taylors School*, from its having been founded by the merchant-taylors company, in the year 1561. It was deſtroyed by the fire of London in 1666, but was rebuilt, and is a very large ſtructure, with commodious apartments for the maſters and uſhers, and a fine library. Sir Thomas White, lord mayor of this city, having founded St John's college in Oxford in 1557, appointed this ſchool as a ſeminary for it, and eſtabliſhed at Oxford 46 fellowſhips for ſcholars elected from this ſchool.

68 St Mary le Bow. The church of *St Mary le Bow*, in Cordwainers-ſtreet ward, is the moſt eminent parochial church in the city. It was originally built in the reign of William the Conqueror; and being the firſt church the ſteeple of which was embelliſhed with ſtone arches or bows, took thence its denomination of le Bow. It was burnt down in the fire of 1666, but ſoon afterwards rebuilt. The ſteeple of this church is reckoned the moſt beautiful of its kind in Europe.

69 Guildhall. In Cheap ward is *Guildhall*, or the townhouſe of London. This was originally built in 1411, but ſo damaged by the great fire already mentioned, as to be rebuilt in 1669. The front has a Gothic appearance; and this character is alſo due to the two gigantic effigies which ſtand within the hall. The hall is 153 feet long, 50 broad, and 55 high, adorned with the royal arms, and thoſe of the city and its companies, as well as with ſeveral portraits of Engliſh ſovereigns and judges. In this building are many apartments for tranſacting the buſineſs of the city, beſides one for each of the judicial courts, namely, that of the King's Bench, the Common Pleas, and the Exchequer.

70 Cheapſide. In the year 1246 Cheapſide was an open field, named *Crown field*, from an inn with the ſign of the crown. At that time, and even for 200 years afterwards, none of the ſtreets of London were paved excepting Thames-ſtreet, and from Ludgate-hill to Charing-Croſs.

71 Goldſmiths Hall. *Goldſmiths Hall* ſtands in Foſter-lane, which opens into the weſt end of Cheapſide.—In this lane alſo is

72 St Mary le Grand. St Martin's le Grand, which, though ſurrounded by the city, was yet ſubject, near three centuries, to Weſtminſter Abbey. A fine college was built here in 700 by Wythred king of Kent; and, about the year 1056, rebuilt and chiefly endowed by Ingelric and Edward, two noble brothers. In 1068, it was confirmed and made independent of every other eccleſiaſtical juriſdiction, even that of the pope himſelf not excepted; and its privileges were confirmed by ſucceeding monarchs. It was governed by a dean, and a number of ſecular canons. In this juriſdiction a magnificent church was erected, but pulled down in 1548, when the college was ſurrendered; after which a tavern was erected on the ſpot.

73 The Croſs and Conduit. A little to the weſtward of Mary le Bow church (in the adjoining ward), ſtood the *Croſs* and *Conduit* in the middle of the ſtreet. The former was built by Edward I. in 1290, in memory of his queen Eleanor,

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London. whose body was rested on that spot in its way to be buried. Originally it had the statue of the queen at full length, resembling exactly that at Northampton. Having at length fallen to decay, it was rebuilt in 1441 by John Hutherby mayor of the city, at the expence of several citizens, being now ornamented with various images, as those of the Resurrection, the Virgin Mary, &c. As the magnificent processions took this road, it was new gilt at every public entry. After the Reformation, the images gave so much offence, that it was thought proper to substitute that of Diana in place of the Virgin Mary. This, however, was resented by Queen Elizabeth, who offered a reward for the discovery of the offenders. As she imagined that a cross, the symbol of the Christian religion, could not justly give offence to any professor of that religion, she ordered a cross to be placed on the summit and gilt; but in 1643, the parliament ordered the demolition of all crosses and other marks of Romish superstition.

Splendid tournaments were held between the Cross and Sopers-lane in the year 1331; but as Queen Philippa and a great number of other ladies, dressed in rich attire, were sitting on the upper scaffolding to behold the sports, the seat gave way, and they suddenly fell down among the knights and others who stood below; many of whom were grievously hurt. The carpenters were saved from punishment by the intercession of the queen; but the king, to prevent accidents of the like nature, ordered a building of stone to be erected near Bow church, from whence the queen and other ladies might behold such spectacles in safety. This was used for the same purpose till the year 1410, when Henry IV. granted it to certain mercers, who converted it into shops, warehouses, and other places necessary for their trade.

A small distance eastward from the Cross stood the Conduit, which served to fill the lesser ones with water brought by pipes from Paddington.—This stood on the spot where the old conduit was situated, which was founded in 1285, constructed of stone lined with lead, and rebuilt in 1479 by Thomas Ilan, one of the sheriffs. On some grand occasions, these conduits have been made to run with claret; as at the coronation of Anna Bullen.

74 Mercers Hall. On the north side of Cheapside stood the *Hospital of St Thomas of Acon*, founded by Fitz-Theobald de Helles, and his wife Agnes, sister to the famous Thomas à Becket. The hospital was built 20 years after the murder of Thomas; and such was his reputation for sanctity, that it was dedicated to him even before he was canonized, and that in conjunction with the Virgin Mary herself. The whole was granted by King Henry VIII. to the company of mercers. It was destroyed by the great fire in 1666; but rebuilt by the mercers company, who have their hall here.—Immediately to the east is a narrow street called the *Old*

75 Old Jewry. *Jewry*, which took its name from a great synagogue which stood here till the Jews were expelled the kingdom in 1291. After them an order of friars named *Fratres de sacca*, or *de penitentia*, took possession of the synagogue: and in 1305, Robert Fitzwalter, the great banner-bearer of the city, requested that the friars might assign it to him; the reason of which probably was, that it stood near to his house, which was situated in the neighbourhood of the present Grocers-hall. The chapel was bought by the grocers from Fitzwalter in 1411 for 320 marks.

In Bassishaw or Basinghall ward, is *Blackwell* or *Bakewell hall*, which adjoins to Guildhall, and is the greatest mart of woollen cloth in the world. It was purchased of King Richard II. by the city; and has ever since been used as a weekly market for broad and narrow woollen cloths, brought out of the country. Formerly proclamations were issued to compel people to bring their goods into the hall, to prevent deceit in the manufactures, which might be productive of discredit in foreign markets, and likewise be the means of defrauding the poor children of Christ's hospital of part of the revenue which arose from the hallage of this great magazine. It suffered in the general devastation in 1666; but was rebuilt in 1672, and is now a spacious edifice, with a stone front adorned with columns. 76 Bakewell Hall.

Cripplegate ward is remarkable for a college, called *Sion College*, founded in 1627, on the site of Elsing-hospital (D) or priory, by Dr Thomas White, vicar of St Dunstan's in the West, for the improvement of the London clergy; and with alms houses, under their care, for 20 poor persons, 10 men and 10 women. In the year 1631, a charter was procured for incorporating the clergy of London, by which they were constituted fellows of the college; and out of the incumbents are annually elected, on Tuesday three weeks after Easter, a president, two deans, and four assistants, who are to meet quarterly, to hear a Latin sermon, and afterwards be entertained at dinner in the college-hall at the expence of the foundation. John Simpson, rector of St Olaves, who superintended the building, added, at his own expence, for the use of the studious part of the London clergy, a library 120 feet long, and amply filled with books. 77 Sion College.

In this ward is a hall which belonged to the company of barber-surgeons, the professions of barber and surgeon being formerly exercised by the same person. It was built by the celebrated Inigo Jones, and the upper end is formed out of one of the towers or barbicans of London wall. The anatomical theatre is elliptical, and very finely contrived. This hall is now called *Barbers hall;* the surgeons, who disdained to be any longer associated with their ancient brethren, having obtained a separate charter, and built themselves a new hall in the Old Bailey. 78 Barbers Hall.

Farringdon ward within, is distinguished by the most magnificent Protestant church in the world, the cathedral of *St Paul*. The best authority we have for the origin of this church, is from its great restorer Sir Christopher Wren. His opinion that there had been a 79 St Paul's Cathedral.

(D) This was founded by William Elsing mercer in 1329 (on the site of a decayed nunnery), for the support of 100 blind men. He afterwards changed it into a priory, and became himself the first prior, who with four canons-regular were to superintend the miserable objects.

London.

a church on this spot, built by the Christians in the time of the Romans, was confirmed: when he searched for the foundations for his own design, he met with those of the original *presbyterium*, or semicircular chancel, of the old church. They consisted only of Kentish rubble stone, artfully worked, and consolidated with exceedingly hard mortar, in the Roman manner, much excelling the superstructure. He explodes the notion of there having been here a temple of Diana, and the discovery of the horns of animals used in the sacrifices to that goddess, on which the opinion had been founded, no such having been discovered in all his searches.

The first church is supposed to have been destroyed in the Dioclesian persecution, and to have been rebuilt in the reign of Constantine. This was again demolished by the pagan Saxons; and restored, in 603, by Sebert, a petty prince, ruling in these parts, under Ethelbert king of Kent, the first Christian monarch of the Saxon race; who, at the instance of St Augustine, appointed Melitus the first bishop of London. Erkenwald, the son of King Offa, fourth in succession from Melitus, ornamented his cathedral very highly, and improved the revenues with his own patrimony. He was most deservedly canonized: for the very litter, in which he was carried in his last illness, continued many centuries to cure fevers by the touch; and the very chips, carried to the sick, restored them to health!

When the city of London was destroyed by fire, in 1086, this church was burnt; the bishop Mauritius began to rebuild it, and laid the foundations, which remained till its second destruction, from the same cause, in the last century. Notwithstanding Mauritius lived twenty years after he had begun this pious work, and Bishop Beauvages enjoyed the see twenty more, yet such was the grandeur of the design, that it remained unfinished. The first had the ruins of the Palatine Tower bestowed on him, as materials for the building; and Henry I. bestowed on Beauvages part of the ditch belonging to the Tower, which, with purchases made by himself, enabled him to enclose the whole with a wall. The same monarch granted, besides, that every ship which brought stone for the church, should be exempted from toll; he gave him also all the great fish taken in his precincts, except the tongues; and, lastly, he secured to him and his successor the delicious tythes of all his venison in the county of Essex.

The style of the ancient cathedral was a most beautiful Gothic; over the east end was an elegant circular window; alterations were made in the ends of the two transepts, so that their form is not delivered down to us in the ancient plans; and from the central tower rose a lofty and most graceful spire. The dimensions, as taken in 1309, were these: The length six hundred and ninety feet; the breadth a hundred and twenty; the height of the roof of the west part, from the floor, one hundred and two; of the east part, a hundred and eighty-eight; of the tower, two hundred and sixty; of the spire, which was made of wood covered with lead, two hundred and seventy-four. The whole space the church occupied was three acres, three roods, and twenty-one perches.

We may be astonished at this amazing building, and naturally inquire what fund could supply money to support so vast an expence. But monarchs resigned their revenues resulting from the customs due for the materials, which were brought to the adjacent wharfs; they furnished wood from the royal forests: prelates gave up much of their revenues; and, what was more than all, by the pious bait of indulgences, and remissions of penance, brought in from the good people of this realm most amazing sums. Pope Innocent III. in 1252, gave a release of sixty days penance; the archbishop of Cologne gave, a few years before, a relaxation of fifty days; and Boniface archbishop of Canterbury, forty days.

The high altar dazzled with gems and gold, the gifts of its numerous votaries. John king of France, when prisoner in England, first paying his respects to St Erkenwald's shrine, offered four basons of gold: and the gifts at the obsequies of princes, foreign and British, were of immense value. On the day of the conversion of the tutelar saint, the charities were prodigious, first to the souls, when an indulgence of forty days pardon was given, *vere pœnitentibus, contritis et confessis;* and, by order of Henry III. fifteen hundred tapers were placed in the church, and fifteen thousand poor people fed in the churchyard.

The holiness of this place did not prevent thieves and profligates of all denominations from lurking within the precincts, and committing, under the favour of the night, murders and every sort of crime. Edward I. gave the dean and canons permission to enclose the whole within a wall; and to have gates to be shut every night, to exclude all disorderly people. Within these walls, on the north-west side, was the bishop's palace. Froissart tells us, that after the great tournament in Smithfield, King Edward III. and his queen lodged here, on occasion of their nuptials (E).—In 1561, the noble spire was totally burnt by lightning, and never restored.

In consequence of the resolutions taken in 1620, by James I.

(E) Before this cathedral was the famous *Paul's Cross*, a pulpit formed of wood, mounted upon steps of stone, and covered with lead, in which the most eminent divines were appointed to preach every Sunday in the forenoon. To this place, the court, the mayor and aldermen, and principal citizens, used to resort. The greatest part of the congregation sat in the open air; the king and his train had covered galleries; and the better sort of people were also protected from the injury of the weather; but the far greater part stood exposed in the open air: for which reason the preacher went in very bad weather to a place called the Shrouds; a covered space on the side of the church, to protect the congregation in inclement seasons. Considerable contributions were raised among the nobility and citizens, to support such preachers as were (as was often the case) called to town from either of the universities. In particular, the lord mayor and aldermen ordered that every preacher, who came from a distance, should be freely accommodated, during five days, with sweet and convenient lodgings, fire, candle, London. James I. to repair the cathedral, the celebrated Inigo Jones was appointed to the work. But it was not attempted till the year 1633, when Laud laid the firſt ſtone, and Inigo the fourth. That great architect begun with a moſt notorious impropriety, giving to the weſt end a portico of the Corinthian order, beautiful indeed, to this ancient Gothic pile; and to the ends of the two tranſepts Gothic fronts in a moſt horrible ſtyle. The great fire made way for the reſtoring of this magnificent pile in its preſent noble form by Sir Chriſtopher Wren, an architect worthy of ſo great a deſign.

It is built of fine Portland ſtone, in form of a croſs. On the outſide are two ranges of pilaſters, conſiſting of a hundred and twenty each; the lower range of the Corinthian order, and the upper of the compoſite. The ſpaces between the arches of the windows and the architrave of the lower order, are filled with a great variety of curious enrichments, as are alſo thoſe above. On the north ſide is a portico, the aſcent to which is by twelve ſteps of black marble, and its dome ſupported by ſix very large columns. Over the dome is a pediment, the face of which is engraved with the royal arms, regalia, and other ornaments. On the ſouth is a portico, the aſcent to which is by twenty-five ſteps, and its dome ſupported by ſix columns. correſponding with thoſe on the north ſide. The weſt front is graced with a moſt magnificent portico, ſupported by twelve lofty Corinthian columns: over theſe are eight columns of the compoſite order, which ſupport a noble pediment, crowned with its acroteria, and in this pediment is the hiſtory of St Paul's converſion, boldly carved in bas relief. The aſcent to this portico is by a flight of ſteps of black marble, extending the whole length of the portico; and over each corner of the weſt front is a beautiful turret. A vaſt dome, or cupola, riſes in the centre of the building. Twenty feet above the roof of the church is a circular range of thirty-two columns with niches, placed exactly againſt others within. Theſe are terminated by their entablature, which ſupports a handſome gallery, adorned with a ſtone baluſtrade. Above the columns laſt mentioned is a range of pilaſters, with windows between them: and from the entablature of theſe, the diameter of the dome gradually decreaſes. On the ſummit of the dome is an elegant balcony, from the centre of which runs a beautiful lanthorn, adorned with Corinthian columns. The whole is crowned with a copper ball, ſupporting a croſs, both finely gilt. Within, the cupola ſtands on eight ſtupendous pillars, curiouſly adorned: the roof of the choir is ſupported by ſix pillars, and that of the church by two ranges, conſiſting of twenty more. The roof of the church and choir is adorned with arches and ſpacious peripheries of enrichments, admirably carved in ſtone. Quite round the inſide of the cupola, there is a whiſpering iron balcony, or gallery, the top of which is richly painted by Sir James Thornhill.

The firſt ſtone of this ſuperb edifice was laid on June 21, 1675; and the building was completed in 1710; but the whole decorations were not finiſhed till 1723. It was a moſt ſingular circumſtance, that, notwithſtanding it was 35 years in building, it was begun and finiſhed by one architect, and under one prelate, Henry Compton biſhop of London. The church of St Peter's was 135 years in building, in the reigns of 19 popes, and went through the hands of twelve architects. It is not, as often miſtaken, built after the model of that famous temple: it is the entire conception of our great countryman, and has been preferred in ſome reſpects, by a judicious writer, to even the Roman Baſilica. Its dimenſions are leſs. The comparative view is given in the Parentalia, and copied in London and its Environs. The height of St Peter's, to the top of the croſs, is 437 feet and an half; that of St Paul's 340 feet; ſo that, from its ſituation, it is lofty enough to be ſeen from the ſea. The length of the firſt is 729 feet; of the latter, 500. The greateſt breadth of St Peter's is 364; of St Paul's, 180.

In the reigns of James I. and Charles I. the body of this cathedral was the common reſort of the politicians, the news-mongers, and idle in general. It was called *Paul's walk;* and is mentioned in the old plays and other books of the times.

Nothwithſtanding the magnificence of this noble pile, however, it is remarked to have many defects. Its ſituation is ſuch, that it cannot be viewed at a diſtance. The diviſion of the porticos, and the whole ſtructure, into two ſtories on the outſide, certainly indicates a like diviſion within, which is acknowledged to be a fault. The dome, it has alſo been obſerved, bears too great a proportion to the reſt of the pile, and ought to have been raiſed exactly in the centre of the building; beſides that, there ought to have been two ſteeples at the eaſt end, to correſpond with thoſe at the weſt. On entering this church, we inſtantly perceive an obvious deficiency, not only of elevation but length, to aſſiſt the perſpective; and the columns are heavy and clumſy, rather encumbering the proſpect than enriching it.

St Paul's occupies an area of ſix acres, and is railed all round with iron baluſtrades, each about five feet and a half high, fixed on a dwarf wall of hewn ſtone. In the weſt end of this area is a marble ſtatue of Queen Anne, holding a ſceptre in one hand, and a globe

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candle, and all neceſſaries. And notice was given by the biſhop of London, to the preacher appointed by him, of the place he was to repair to.

We hear of this being in uſe as early as the year 1259. It was uſed, as Mr Pennant obſerves, not only for the inſtruction of mankind by the doctrine of the preacher, but for every purpoſe political or eccleſiaſtical; for giving force to oaths, for promulging of laws, or rather the royal pleaſure, for the emiſſion of papal bulls, for anathematizing ſinners, for benedictions, for expoſing of penitents under cenſure of the church, for recantations, for the private ends of the ambitious, and for the defaming of thoſe who had incurred the diſpleaſure of crowned heads.

It was demoliſhed in 1643 by order of parliament, executed by the willing hands of Iſaac Pennington the fanatical lord mayor of that year, who died in the Tower a convicted regicide.

London. globe in the other, ſurrounded with four emblematical figures repreſenting Great Britain, France, Ireland, and America.

Beſides very large contributions for carrying on this edifice, the parliament granted a duty on ſea-coal, which, at a medium, produced 5000l. a-year; and the whole expence of the building is ſaid to have amounted to 736,752l. 2s. 3d.

On the eaſt ſide of the cathedral is *St Paul's School*, founded in 1509 by Dr John Collet dean of this church, who endowed it for a principal maſter, an under-maſter, a chaplain, and 153 ſcholars.

80 College of Phyſicians. In Warwick-lane, in the ſame ward, ſtands the *College of Phyſicians*, erected in 1682 by Sir Chriſtopher Wren. It is built of brick, and has a ſpacious ſtone frontiſpiece. Near the ſouth extremity of the Old Bailey, on the eaſt ſide, is the hall of the Company of Surgeons, with a theatre for diſſection.

81 Chriſt's Hoſpital. Adjoining to Chriſt-church in Newgate-ſtreet is *Chriſt's Hoſpital*, which, before the diſſolution of monaſteries by Henry VIII. was a houſe of Gray-friars. The hoſpital was founded by King Edward VI. for ſupporting and educating the fatherleſs children of poor freemen of this city; of whom 1000 of both ſexes are generally maintained in the houſe or out at nurſe, and are likewiſe clothed and educated. In 1673, a mathematical ſchool was founded here by Charles II. endowed with 320l. a-year; and a writing ſchool was added in 1694 by Sir John Moor, an alderman of the city. After the boys have been ſeven or eight years on the foundation, ſome are ſent to the univerſity and others to ſea; while the reſt, at a proper age, are put apprentices to trades at the charge of the hoſpital. At firſt their habit was a ruſſet cotton, but was ſoon after changed for blue, which has ever ſince continued to be their colour; and on this account the foundation is frequently called the *Blue-coat hoſpital*. The affairs of this charity are managed by a preſident and about 300 governors, beſides the lord mayor and aldermen. The fabric, which is partly Gothic and partly modern, was much damaged by the fire of 1666, but was ſoon repaired, and has been ſince increaſed with ſeveral additions. The principal buildings, which form the four ſides of an area, have a piazza round them with Gothic arches, and the walls are ſupported by abutments. The front is more modern, and has Doric pilaſters ſupported on pedeſtals.

82 Doctors Commons. In Caſtle-Baynard ward is a large ſtructure called *Doctors Commons*. It conſiſts of ſeveral handſome paved courts, in which the judges of the court of admiralty, thoſe of the court of delegates, of the court of arches, and the prerogative court, with the doctors that plead cauſes, and the proctors of the place, all live in a collegiate way; and from commoning together, as in other colleges, the name of Doctors Commons is derived. Here courts are kept for the trial of civil and eccleſiaſtical cauſes under the archbiſhop of Canterbury and the biſhop of London. The college has an excellent library, every biſhop at his conſecration giving 25l. or 50l. towards purchaſing books for it.

83 College of Heralds. Near Doctors Commons, on St Bennet's Hill, is the *College of Heralds*, who were incorporated by King Richard III. Beſides the chief officer, who is the earl-marſhal of England, here are three kings at arms, viz. Garter, Clarencieux, and Norroy, with ſix heralds, four purſuivants, and eight proctors. Garter attends the inſtalments of knights of that order, carries the garter to foreign princes, regulates the ceremonies at coronations, and the funerals of the royal family and nobility: Clarencieux directs the funeral ceremonies of thoſe under the degree of peers ſouth of Trent; and Norroy performs the like office for thoſe north of Trent. This building was originally the houſe of the earl of Derby. It is a ſpacious quadrangle, built of brick, and has convenient apartments. Here are kept records of the coats of arms of all the families and names in England, with an account when they were granted, and on what occaſion.

In Farringdon ward without, is a large building called *Bridewell*, from a ſpring formerly known by the name of St Bridget's or St Bride's Well. It was originally a royal palace, and occupied all the ground from Fleet-ditch on the eaſt to Water-lane on the weſt. That part of it now called *Saliſbury-court* was given to the biſhops of Saliſbury for their town reſidence; and the eaſt part, which was rebuilt by King Henry VIII. is the preſent Bridewell. It was granted to the city by Edward VI. as an hoſpital; and he endowed it for the lodging of poor travellers, and for the correction of vagabonds, ſtrumpets, and idle perſons, as well as for finding them work. In one part of the building 20 artificers have houſes; and about 150 boys, diſtinguiſhed by white hats and blue doublets, are put apprentices to glovers, flaxdreſſers, weavers, &c. and when they have ſerved their time are entitled to the freedom of the city, with 10l. towards carrying on their reſpective trades. The other part of Bridewell is a receptacle for diſorderly perſons, who are kept at beating hemp and other hard labour. 84 Bridewell.

Near Bridewell is *St Bride's Church*, a ſtately fabric 111 feet long, 57 broad, and 41 high, with a beautiful ſpire 234 feet in altitude, and has a ring of 12 bells in its tower.

Oppoſite to Fleet-ditch, over this part of the river, ſtands *Blackfriars Bridge*; a moſt elegant ſtructure, built after the deſign of Mr Robert Mylne. The ſituation of the ground on the two ſhores obliged the architect to employ elliptical arches; which, however, have a very fine effect. The number of arches is nine; of which the centre one is 100 feet wide. The whole length is 995 feet; the breadth of the carriage-way is 28 feet, and that of the two foot-ways 7 each. Over each pier is a receſs; an apology for the beautiful Ionic pillars which ſupport them, and which have a moſt beautiful effect from the river. This bridge was begun in 1760; and finiſhed in 1768, at the expence of 152,840l. to be diſcharged by a toll upon the paſſengers. It is ſituated almoſt at an equal diſtance between thoſe of Weſtminſter and London, commands a view of the Thames from the latter to Whitehall, and diſcovers the majeſty of St Paul's in a very ſtriking manner. 85 Blackfriars Bridge.

Weſt Smithfield. In this ward is an area containing three acres of ground, called in old records *Smithfield-Pond* or *Horſe-Pool*, it having been formerly a watering place for horſes. It was in ancient times the common place of execution; and at the ſouth-weſt corner there was a gallows called the *Elms*, from a number of elm-trees 86 Smithfield.

 trees that grew in the neighbourhood. It was likewiſe the ſcene of public juſts and tournaments, and has been a market-place for cattle above 500 years.

87 St Bartholomew's Hoſpital.

On the ſouth ſide of this area, and contiguous to Chriſt's hoſpital, is *St Bartholemew's Hoſpital.* It was originally founded ſoon after the acceſſion of Henry I. by Rahere the king's jeſter, as an infirmary for the priory of St Bartholemew the Great, which then ſtood near the ſpot. But upon the diſſolution of religious houſes, Henry VIII. refounded it, and endowed it with 500 marks a-year, on condition that the citizens ſhould pay the ſame ſum annually for the relief of 100 lame and infirm patients. The endowments of this charity have ſince been ſo much enlarged, that it now receives the diſtreſſed of all denominations. In 1702, a beautiful frontiſpiece was erected towards Smithfield, adorned with pilaſters, entablature, and a pediment of the Ionic order, with a ſtatue of King Henry VIII. ſtanding in a niche in full proportion, and thoſe of two cripples on the top of the pediment over it. In 1729, a plan was formed for rebuilding the reſt of this hoſpital, in conſequence of which a magnificent edifice has been erected.

Among many other privileges granted by Henry I. to the prior and canons of the monaſtery of St Bartholomew the Great, and to the poor of the infirmary, was that of keeping a fair in Smithfield on the eve, day, and morrow, of St Bartholomew. This fair, called *Bartholomew-fair*, has been held annually ever ſince: and by the indulgence of the magiſtrates of London, to whom the privilege of keeping it devolved upon the diſſolution of the priory, it uſed to continue a fortnight. A great number of booths was erected in it by the actors of the theatres, for the exhibition of dramatic performances of various kinds; and it became at length a ſcene of ſo much licentiouſneſs and riot, that Sir John Barnard when lord mayor of London reduced the time of the fair to its original duration of three days. This laudable example has been followed ever ſince; and the magiſtrates have likewiſe prohibited all public exhibitions which had been formerly accompanied with ſo much diſorder.

88 Old Bailey.

In a ſtreet in this ward, called the *Old Bailey*, is a hall named *Juſtice hall*, or the *Seſſion's houſe*, where a court is held eight times a-year by the king's commiſſion of oyer and terminer for the trial of criminals for offences committed within the city of London and county of Middleſex. The judges of this court are the lord mayor, thoſe of the aldermen that have ſerved that office, and the recorder; who are attended by the ſheriffs and by one or more of the national judges.

89 Newgate.

In this ſtreet is alſo the great criminal priſon, lately built in a much more convenient ſituation, and on a more enlarged plan, than the former priſon, called *Newgate*: by which name it is ſtill diſtinguiſhed. Here the unfortunate debtor will no longer be annoyed by the dreadful rattle of chains, or by the more horrid ſounds iſſuing from the lips of thoſe wretched beings who ſet defiance to all laws divine and human; and here alſo, the offender, whoſe crime is not capital, may enjoy all the benefits of a free open air.

90 Fleet-priſon.

In this ward is likewiſe a priſon called the *Fleet Priſon*, from a ſmall river named the Fleet which formerly ran by it: this building is large, and reckoned the beſt in the city for good rooms and other conveniences. It has the benefit of a large yard, which is encloſed with a very high wall. This priſon is as ancient as the reign of Richard I. and belongs to the court of chancery, &c.

In Chancery-lane, in this ward, is an office conſiſting of a houſe and chapel, called the office and chapel of the *Rolls*, from being the great repoſitory of the modern public rolls and records of the kingdom. This building was originally the houſe of an eminent Jew; but being forfeited to the crown, King Henry III. in the year 1223 converted it into a hoſpital for the reception and accommodation of Jewiſh and other proſelytes. In 1377, Edward III. granted this hoſpital and its chapel to William Burſtall maſter of the rolls, to whoſe ſucceſſors in that office it has ever ſince belonged. Round this office there is a ſmall diſtrict conſiſting of about 200 houſes, called the *Liberty of the Rolls*, over which the magiſtrates of London have no authority, it being under the government of the maſter of the rolls.

91 The Rolls.

In this ward are ſeveral *Inns* of court and chancery, particularly the Inner and Middle Temple, Serjeants Inn, Clifford's Inn, Barnard's Inn, Staple's Inn, and Furnival's Inn.

92 The Temple.

The *Temple* received its name from being originally founded by the Knights Templars, who ſettled here in 1185. It was at firſt called the *New Temple*, to diſtinguiſh it from the former houſe of the Knights Templars, which ſtood in Holborn near Chancery lane.

The original building was divided into three parts; the Inner, the Middle, and the Outer Temple. The Inner and the Outer Temple were ſo called, becauſe one was within and the other was without the Bar; and the Middle derived its name from being ſituated between them. Upon the diſſolution of the order of Knights Templars, the New Temple devolved to the Knights Hoſpitallers of St John of Jeruſalem, who granted a leaſe of it to the ſtudents of the common law, and converted that part of it called Inner and Middle Temple into two inns of court for the ſtudy and practice of the common law. The Outer Temple became a houſe for the earl of Eſſex.

The buildings of the Temple eſcaped the fire in 1666, but were moſt of them deſtroyed by ſubſequent fires, and have ſince been rebuilt. The two Temples are each divided into ſeveral courts, and have pleaſant gardens on the banks of the Thames. They are appropriated to diſtinct ſocieties, and have ſeparate halls, where the members dine in common during term-time. The Inner Temple hall is ſaid to have been built in the reign of Edward III. and the middle Temple hall, which is a magnificent edifice, was rebuilt in 1572 in form of a college hall. The Middle Temple gate, Mr Pennant informs us, was erected by Sir Amias Powlet on a ſingular occaſion. It ſeems that Sir Amias, about the year 1501 thought fit to put Cardinal Wolſey, then parſon of Lymington, into the ſtocks. In 1515, being ſent for to London by the cardinal on account of that ancient grudge, he was commanded not to quit town till farther orders. In conſequence, he lodged five or ſix years in this gateway, which he rebuilt; and to pacify his eminence, adorned the front with the cardinal's cap, badges, cogniſance, and other devices of this butcher's ſon; ſo low were the great

London.

men obliged to stoop to that meteor of the times! Each temple has a good library, adorned with paintings, and well furnished with books. An assembly, called a *parliament*, in which the affairs of the society of the Inner Temple are managed, is held there every term. Both Temples have one church, first founded in 1185, by the Knights Templars; but the present edifice is supposed to have been built in 1420. It is supported by neat slender pillars of Sussex marble, and is one of the most beautiful Gothic structures in England. In this church are many monuments, particularly of nine Knights Templars cut in marble in full proportion, some of them seven feet and a half long; six are cross-legged, and therefore supposed to have been engaged in the crusades. The minister of this church, who is usually called the *master of the Temple*, is appointed by the benchers or senior members of both societies, and presented by a patent from the crown. Shakespeare (whether from tradition or history) makes the Temple garden the place in which the badge of the white and red rose originated; the distinctive badge of the houses of York and Lancaster, under which the respective partizans of each arranged themselves in the fatal quarrel which caused such torrents of English blood to flow.

Near the Temple-bar is the *Devil's Tavern*, so called from its sign of St Dunstan seizing the evil spirit by the nose with a pair of hot tongs. Ben Johnson has immortalized it by his *Leges Conviviales*, which he wrote for the regulation of a club of wits held in a room he dedicated to Apollo; over the chimney-piece of which they are preserved. The tavern was in his days kept by Simon Wadloe; whom, in a copy of verses over the door of the Apollo, he dignified with the title of *King of Skinkers*.

93 Inns of Chancery.

Serjeants Inn is a small inn in Chancery-lane, where the judges and serjeants have chambers, but not houses, as they had in another inn of this name in Fleet-street, which they abandoned in 1730; but in each of them there is a hall and a chapel. *Clifford's Inn* is an inn of chancery belonging to the Inner Temple. It was originally a house granted by Edward II. to the family of the Cliffords, from which it derived its name; but was afterwards let upon lease to the students of the law, and in the reign of Edward III. sold to the members of this society. *Bernard's Inn* is likewise an inn of chancery belonging to Gray's Inn. It stands in Holborn, and was the house of John Mackworth, dean of Lincoln, who gave it to the professors of the law. *Staple's Inn* belongs also to Gray's Inn, and is situated in Holborn. It was once a hall for the merchants of the staple for wool, whence it derives its name; but it was purchased by the benchers of Gray's Inn, and has been an inn of chancery since the year 1415. *Furnival's Inn* is an inn of chancery belonging to Lincoln's Inn, and was once the house of the family of the Furnivals, by whom it was let out to the professors of the law. It is a large old building, with a hall and a pleasant garden.

94 Bethlehem Hospital.

In Coleman-street ward, on the south side of a large square called *Moorfields*, stood *Bethlehem Hospital*, founded in 1675 by the lord mayor and citizens of London for the reception and cure of poor lunatics. It was a noble edifice, built with brick and stone, and adorned with pilasters, entablatures, and sculpture; particularly with the figures of two lunatics over the grand gate, which are well executed. This building was 540 feet long and 40 broad, exclusive of two wings of a later erection, intended for the reception of such lunatics as were deemed incurable. This hospital contained a great number of convenient cells or apartments, where the patients were maintained and received all medical assistance without any other expence to their friends than that of bedding. The structure was divided into two stories, through each of which ran a long gallery from one end of the house to the other. On the south side were the cells, and on the north the windows that gave light to the galleries, which were divided in the middle by handsome iron gates, to keep the men and women separate. This hospital being pulled down, it is intended to erect another building for the use of the same charity, a ta short distance from the metropolis. A new road is to be opened from the site of the old hospital to the Royal Exchange.

95 St Luke's Hospital.

Opposite to Bethlehem hospital stood that of *St Luke*, a long plain building, till of late appropriated to the same purposes, but wholly independent of the former. It was founded on the humane consideration that Bethlehem was incapable of receiving all the miserable objects which were offered. Of late years the patients were removed from the old hospital to a new one erected under the same name in Old-street, on the plan of the former, extending in front 492 feet. The old hospital is now pulled down, and replaced by a handsome row of houses. Uncured patients may be taken in again, by a very liberal regulation, on the payment of five shillings a week; so that their friends may, if they choose, try a second time the force of medicine on their unhappy relations or acquaintances.

96 Different markets.

Besides the three markets already mentioned at Smithfield for cattle and hay, at Leadenhall for butchers meat, wool, hides, and Colchester baize, and at Billingsgate for fish; there are in this city the following other markets, which are all very considerable, viz. Honey-lane, Newgate, and Fleet-market, chiefly for flesh, though with separate divisions for fish, butter, eggs, poultry, herbs, and fruit; and the Three-Cranes market, for apples and other fruit. The principal corn-market is held in a neat exchange situated in Market-lane, and that for flour at Queenhithe. In Thames-street, near Billingsgate, there is an exchange for dealers in coals and masters of vessels in that trade to transact their business.

97 2. Borough of Southwark, its jurisdiction, &c.

II. *The Borough of* Southwark. It was called by the Saxons *Suth*, or the "South work," in respect to some fort or fortification bearing that aspect from London. It was also called the Borough, or *Burg*, probably from the same reason. It was long independent of the city of London: but, in consideration of the inconveniences arising from the escape of malefactors from the great capital into this place, it was in 1327 granted by Edward III. to the city, on payment of 10l. annually. It was then called the *village* of Southwark; it was afterwards styled the *bailiwick* of Southwark, and the mayor and commonalty of London appointed the bailiff. This power, however, not being sufficient to remedy the evil, a more intimate connexion was thought necessary; and in the reign of Edward VI. on a valuable consideration paid to the crown, it was formed into a 26th ward, by the title of *Bridge-Ward Without*; with a reservation of certain privileges

privileges enjoyed there by the archbiſhop of Canterbury and ſome other eccleſiaſtics. In conſequence of this, it was ſubjected to the lord mayor of London, with the ſteward and bailiff. But Southwark being divided into two parts, this is to be underſtood of the diviſion called the *Borough Liberty*, which conſiſts of three of the pariſhes belonging to the town, with the greater part of a fourth pariſh. For the city diviſion, the lord mayor by his ſteward holds a court of record every Monday at the ſeſſions-houſe on St Margaret's Hill in this borough for all debts, damages, and treſpaſſes within the limits of his juriſdiction. The other diviſion is called the *Clink*, or the *Manor of Southwark*, and is ſubdivided into the Great Liberty, the Guildhall, and the King's Manor; for each of which ſubdiviſions a court-leet is held, where the conſtables, ale-
98 Courts. conners, and fleſh-taſters, are choſen, and other buſineſs of this kind tranſacted. A court-houſe, called *Union Hall*, has lately been built in the new ſtreet called *Union-ſtreet*, which leads in a direct line from the high-ſtreet in the Borough to Great Surry-ſtreet Blackfriars road. The Clink liberty is under the juriſdiction of the biſhop of Wincheſter, who, beſides a court-leet, keeps here a court of record on the Bankſide near St Saviour's church by his ſteward or bailiff, for pleas of debt, damages, and treſpaſſes. Court-leets are alſo kept at Lambeth, Bermondſey, and Rotherhithe, three ſmall diſtricts adjoining to the Borough.
99 Priſons. —There is a compter for the impriſonment of offenders in the bailiwick, and another for the Clink liberty; to which may be added the Surry workhouſe for vagrants. Beſides theſe, there is the Marſhalſea-priſon, which is the county gaol for felons, and the admiralty gaol for pirates (G); in which is a court firſt erected for trials of cauſes between the king's domeſtics or menial ſervants, of which the knight-marſhal is preſident, and his ſteward judge, to whom belong four counſellors and ſix attorneys; and the court is held every Friday by him or his deputy, for debt, damages, and treſpaſſes, in cauſes for 10 miles round Whitehall, excepting London. In this quarter is alſo the King's Bench priſon, the rules of which are above two miles in circuit, and compriſe the greateſt part of St. George's Fields. Here was committed Henry prince of Wales, afterwards King Henry V. by the ſpirited and honeſt Judge Gaſcoigne, for ſtriking or inſulting him on the bench. In this priſon the allowance is ſomewhat better than that of the common priſons; for which reaſon, many debtors remove themſelves hither by *habeas corpus*. It is properly a place of confinement in all caſes triable in the King's Bench court.—The firſt time that Southwark is mentioned in hiſtory is on occaſion of Earl Goodwin's ſailing up the river to attack the royal navy of 50 ſhips lying before the palace of Weſtminſter: this was in 1052, when we are told he went *ad Suthweorce*, and ſtaid till there the return of the tide.

100 Pariſhes, &c. Southwark conſiſts of the pariſhes of St Olave, St Saviour, St George, and St Thomas; the pariſh of Chriſt-church, though contiguous to the borough, is in the county of Surry.

The principal church in Southwark is that of *St Saviour*, which was formerly a priory of regular canons. Being dedicated to the Virgin Mary, and ſituated near the bank of the Thames, it was called *St Mary Over Ree*, or *Overy*, by which appellation it is commonly known. This church is built in the manner of a cathedral, with three aiſles from eaſt to weſt, and a croſs aiſle. It is reckoned the largeſt pariſh-church in England, the three aiſles firſt mentioned meaſuring 269 feet in length, and the croſs aiſle 109 feet. The height within is 47 feet, and it has a tower with four ſpires 150 feet high.

Not far from St George's church ſtood the magnificent palace of Charles Brandon duke of Suffolk, the deſerved favourite of Henry VIII. After his death, in 1545, it came into the king's hands, who eſtabliſhed here a royal mint. It at that time was called *Southwark Place*, and in great meaſure preſerved its dignity. Edward VI. once dined in it. His ſiſter and ſucceſſor preſented it to Heath archbiſhop of York, as an inn or reſidence for him and his ſucceſſors whenever they repaired to London. As to the Mint, it became a ſanctuary for inſolvent debtors; but at length becoming the peſt of the neighbourhood, by giving ſhelter to villains of every ſpecies, that awakened the attention of parliament; which by the ſtatutes 8 and 9 Will. III. 9 George I. and 11 George I. entirely took away its abuſive privileges.

In the pariſh of Chriſt-church, near the water on Bankſide, ſtood *Paris-garden*, one of the ancient play- 101 Ancient places of diverſion.
houſes of our metropolis. Ben Johnſon is reproached by one Decker, an envious critic, with his ill ſucceſs on the ſtage, and in particular with having performed the part of Zuliman at Paris-garden. It ſeems to have been much frequented on Sundays. This profanation (Mr Pennant obſerves) was at length fully puniſhed by the dire accident which befel the ſpectators in 1582, when the ſcaffolding ſuddenly fell, and multitudes of people were killed or miſerably maimed. The omen ſeems to have been accepted; for in the next century the manor of Paris-garden was erected into a pariſh, and a church founded under the name of Chriſt's.

Beyond this place of amuſement were the Bear-garden and place for baiting of bulls, the *Britiſh circi;* "Herein (ſays Stow) were kept beares, bulls, and other beaſts to be bayted; as alſo maſtives in ſeveral kennels nouriſhed to bayt them. Theſe beares and other beaſts are there kept in plots of ground ſcaffolded about for the beholders to ſtand ſafe." This was then an amuſement for perſons of the firſt rank: our great, if not good, Elizabeth cauſed the French ambaſſadors to be carried to this theatre, to divert them with theſe bloody ſpectacles.

Not far from theſe ſcenes of cruel paſtime was the 102 The Stews.
Bordello

(G) In 1377 this priſon was broken open by a mob of ſailors, who murdered a gentleman confined in it for killing one of their comrades, and who had been pardoned by the court. It was again broken open by Wat Tyler and his followers in 1381. It eſcaped in the infamous riots of 1780, while the King's Bench, the Borough Priſon, and the Clink Priſon, were nearly at the ſame inſtant ſacrificed to their fury.

London. *Bordello* or *Stews*, permitted and openly licensed by government, under certain laws or regulations. They were farmed out. Even a lord mayor did not disdain to own them: but rented them to the *Froes*, that is, "the bawds," of Flanders. Among other singular regulations, no stewholder was to admit married women; nor were they to keep open their houses on Sundays; nor were they to admit any women who had on them the perilous infirmity of burning. These infamous houses were very properly suppressed in the reign of Henry VIII.

The bishop of Winchester had formerly a palace here with a park (the same that is now called *Southwark-park*), which is since converted into warehouses and tenements, held by lease from the bishops of that see.

103 St Thomas's Hospital. Besides several alms-houses, there are here *St Thomas's* and *Guy's Hospitals*, two of the noblest endowments in England. The former was first erected in 1215 by Peter de Rupibus bishop of Winchester, who endowed it with land to the amount of 343l. a-year; from which time it was held of the abbots of Bermondsey, one of whom in 1428 granted a right to the master of the hospital to hold all the lands it was then in possession of belonging to the said abbot and convent, the whole revenue of which did not exceed 266l. 17s. 6d. per annum. In the year 1551, after the citizens of London had purchased of Edward VI. the manor of Southwark and its appurtenances, of which this hospital was a part, they expended 1100l. in repairing and enlarging the edifice, and immediately received into it 260 patients; upon which the king in 1553 incorporated this hospital with those of Christ-church and Bridewell in the city of London. The building being much decayed, three beautiful squares adorned with colonnades were erected by voluntary subscription in 1693, to which in 1732 the governors added a magnificent building, consisting of several wards with proper offices. The annual disbursements of this hospital have for many years amounted to 8000l. The house is divided into 19 wards, and is said to contain 474 beds.

104 Guy's Hospital. Adjoining to St Thomas's stand *Guy's Hospital*, perhaps the most extensive charitable foundation that ever was established by one man in private life. The founder of this hospital was Thomas Guy, a bookseller in Lombard-street, London, who lived to see the edifice roofed in; and at his death, in 1724, left 238,292l. 16s. including the expence of the building, to finish and endow it. This hospital consists of two capacious squares, containing 12 wards and 435 beds. It was incorporated by charter from parliament, and the first governors were appointed in 1725.

In St George's Fields, westward of the King's Bench prison, is the *Magdalen Hospital* for the reception of penitent prostitutes; a little farther is situated the Asylum for orphan girls; and not far distant is the Westminster Lying-in Hospital: Institutions, of which the following feeling and animated account is given by Mr Pennant.

105 The Asylum. "The *Asylum* is an institution of a most heavenly nature, calculated to save from perdition of soul and body the brighter part of the creation; such on whom Providence hath bestowed angelic faces and elegant forms, designed as blessings to mankind, but too often debased to the vilest uses. The hazard that these innocents constantly are liable to from a thousand temptations, from poverty, from death of parents, from the diabolical procuress, and often from the stupendous wickedness of parents themselves, who have been known to sell their beauteous girls for the purpose of prostitution, induced a worthy band to found in the year 1758 the Asylum or House of Refuge. Long may it flourish, and eternal be the reward of those into whose minds so amiable a conception entered!

106 The Magdalen Hospital. "To afford means of salvation to those unhappy beings who had the ill fortune to lose the benefits of this divine institution, the *Magdalen Hospital* was instituted for the reception of the penitent prostitutes. To save from vice, is one great merit. To reclaim and restore to the dignity of honest rank in life, is certainly not less meritorious. The joy at the return of one sinner to repentance is esteemed by the highest authority worthy of the heavenly host. That ecstasy, I trust, this institution has often occasioned. Since its foundation in the same year with the former, to December 25. 1786, not fewer than 2471 have been admitted. Of these (it is not to be wondered that long and evil habits are often incurable) 300 have been discharged, uneasy under constraint; 45 proved lunatics, and afflicted with incurable fits; 60 have died; 52 never returned from hospitals they were sent to; 338 discharged for faults and irregularities. How to be dreaded is the entrance into the bounds of vice, since the retreat from its paths is so difficult! Finally, 1608 prodigals have been returned to their rejoicing parents; or placed in reputable services, or to honest trades, banes to idleness and securities against a future relapse." Into this charity, every woman who has been seduced (and is not pregnant or diseased), whether recommended or not, may apply for admission to the committee, who meet for that purpose on the first Tuesday in every month.

107 Lying-in Hospital. Akin to those charities is that of the *Lying-in Hospital*: which is not intended merely for the reception of "the honest matron who can deposite her burden with the consciousness of lawful love; but also for the unhappy wretches whom some villain in the unguarded moment has seduced, and then left a prey to desertion of friends, to poverty, want, and guilt.—Lest such 'may be driven to despair by such complicated misery, and be tempted to destroy themselves and murder their infants,' here was founded in 1765 this humane preventive, the Westminster New Lying-in Hospital, in which every assistance and accommodation requisite in such situations are provided in the most attentive and liberal manner. To obviate all objection to its being an encouragement to vice, no one is taken in a second time: but this most excellent charity is open to the worthy distressed matron as often as necessity requires. None are rejected who have friends to recommend. And of both descriptions upwards of 4000 have experienced its salutary effect."

108 St George's Fields. St George's Fields are now almost covered with new erected buildings, from the ditch at the end of Great Surry-street, or Burrow's Buildings, to the Fishmongers alms-houses, in one direction; and from the Marshalsea prison to the Dog and Duck, in the other direction; with several irregular indentations in its circumference: And where the principal roads meet, an obelisk has been erected, pointing out the distance it stands

London.

from different parts of London, Weſtminſter, and Blackfriars bridges. Among the buildings which ſerve to embelliſh and improve this entrance to London, Chatham-ſquare and Bridgeſtreet-Blackfriars may be particularly ſpecified.

109 Lambeth Palace,

At *Lambeth*, the archbiſhops of Canterbury have had a palace. According to Mr Pennant, it was in the earlier times a manor, poſſibly a royal one: for the great Hardiknut died here in 1042, in the midſt of the jollity of a wedding dinner; and here, without any formality, the uſurper Harold is ſaid to have ſnatched the crown and placed it on his own head. At that period it was part of the eſtate of Goda, wife to Walter earl of Mantes, and Euſtace earl of Boulogne; who preſented it to the church of Rocheſter, but reſerved to herſelf the patronage of the church. It became in 1197 the property of the ſee of Canterbury, by exchange tranſacted between Glanville biſhop of Rocheſter and the archbiſhop Hubert Walter. The building was improved by Langton the ſucceſſor of Walter; but it was afterwards neglected and became ruinous. "No pious zeal (ſays Mr Pennant) reſtored the place, but the madneſs of prieſtly pride. Boniface, a wrathful and turbulent primate, elected in 1244, took it into his head to become a viſitor of the priory of St Bartholomew, to which he had no right. The monks met him with reverential reſpect, but aſſured him the office did not belong to the biſhop. The meek prelate ruſhed on the ſub-prior, knocked him down, kicked, beat, and buffeted him, tore the cope off his back, and ſtamped on it like one poſſeſſed, while his attendants paid the ſame compliments to all the poor monks. The people enraged at his unprieſtly conduct would have torn him to pieces; when he retired to Lambeth, and, by way of expiation, rebuilt it with great magnificence. At a ſubſequent period it was very highly improved by the munificent Henry Chichely, who enjoyed the primacy from 1414 to 1443. I lament to find ſo worthy a man to have been the founder of a building ſo reproachful to his memory as the Lollards tower, at the expence of near 280l. Neither Proteſtants or Catholics ſhould omit viſiting this tower, the cruel priſon of the unhappy followers of Wickliffe. The vaſt ſtaples and rings to which they were chained before they were brought to the ſtake, ought to make Proteſtants bleſs the hour which freed them from ſo bloody a religion." During the civil wars of the laſt century, this palace ſuffered greatly; but at the Reſtoration, the whole was repaired by Archbiſhop Juxton.

110 and Church.

The pariſh church of Lambeth (H), which is at a ſmall diſtance from the palace, has a plain tower; and the architecture is of the Gothic of the time of Edward IV. It has very little remarkable in it, except the figure of a pedlar and his dog, painted in one of the windows; and tradition ſays, that the pariſh was obliged to this man for the bequeſt of a piece of land, which bears the name of the *Pedlar's Acre*. In the churchyard is the tomb of old Tradeſcant. Both father and ſon were great travellers; and the former is ſuppoſed to have viſited Ruſſia and moſt parts of Europe, Turkey, Greece, many of the eaſtern countries, Egypt, and Barbary; out of which he introduced multitudes of plants and flowers, unknown before in our gardens. The monument is an altar tomb; embelliſhed with emblematical ſculptures; and bearing the following inſcription, which is both ſingular and hiſtorical:

> Know, ſtranger, ere thou paſs, beneath this ſtone
> Lye John Tradeſcant, grandſire, father, ſon;
> The laſt dy'd in his ſpring; the other two
> Liv'd till they had travell'd Art and Nature through,
> As by their choice collections may appear,
> Of what is rare, in land, in ſea, in air;
> Whilſt they (as Homer's Iliad in a nut)
> A world of wonders in one cloſet ſhut:
> Theſe famous Antiquarians, that had been
> Both gardeners to the Roſe and Lily Queen,
> Tranſplanted now themſelves, ſleep here; and when
> Angels ſhall with their trumpets waken men,
> And fire ſhall purge the world, theſe hence ſhall riſe,
> And change this garden for a paradiſe.

111 Lambeth Marſh.

From Lambeth, eaſtward along the river ſide, was once a long tract of dreary marſh, and ſtill in parts called *Lambeth Marſh*; about the year 1560, there was not a houſe on it from Lambeth palace as far as Southwark. In a ſtreet called *Narrow-wall* (from one of the ancient embankments) is Mrs Conde's noted manufactory of artificial ſtone (I): And at a ſmall diſtance, Meſſ. Beaufoy's (K) great work

112 Great Manufactories.

(H) In deſcribing this church, Mr Pennant takes occaſion to mention the ſad example of fallen majeſty in the perſon of Mary d'Eſte, the unhappy queen of James II.; who, flying with her infant prince from the ruin impending over their houſe, after croſſing the Thames from the abdicated Whitehall, took ſhelter beneath the ancient walls of this church a whole hour, from the rain of the inclement night of December 6. 1688. Here ſhe waited with aggravated miſery, till a common coach, procured from the next inn, arrived, and conveyed her to Graveſend, from whence ſhe ſailed, and bade an eternal adieu to theſe kingdoms.

(I) Her repoſitory conſiſts of ſeveral very large rooms filled with every ornament, which can be uſed in architecture. The ſtatue, the vaſe, the urn, the rich chimney pieces, and in a few words, every thing which could be produced out of natural ſtone or marble by the moſt elegant chiſel, is here to be obtained at an eaſy rate.

(K) "Where (ſays Mr Pennant) the foreign wines are moſt admirably mimicked. Such is the prodigality and luxury of the age, that the demand for many ſorts exceeds in a great degree the produce of the native vineyards. We have ſkilful fabricators, who kindly ſupply our wants. It has been eſtimated, that half of the port, and five-ſixths of the white wines conſumed in our capital, have been the produce of our home wine preſſes. The product of duty to the ſtate from a ſingle houſe was in one year, from July 5. 1785 to July 5. 1786, not leſs than 7363l. 9s. 8½d. The genial banks of the Thames oppoſite to our capital, yield almoſt every ſpecies of white wine; and, by a wondrous magic, Meſſ. Beaufoy pour forth the materials for the rich Frontiniac,

London.

work for making wines, and that for making vinegar (L).

This ground, ſo profitable to the proprietors, and ſo productive of revenue to the ſtate, was within memory the ſcene of low diſſipation. Here ſtood Cuper's garden, noted for its fireworks, and the great reſort of the profligate of both ſexes. This place was ornamented with ſeveral of the mutilated ſtatues belonging to Thomas earl of Arundel, which had been for that purpoſe begged from his lordſhip by one Boyder Cuper, a gardener in the family. The great timber yards beneath which theſe antiquities were found, are very well worthy of a viſit. One would fear that the foreſts of Norway and the Baltic would be exhauſted, to ſupply the wants of our overgrown capital, were we not aſſured that the reſources will ſucceſſively be increaſed equal to the demand of ſucceeding ages.—In this pariſh are alſo vaſt diſtilleries, formerly the property of Sir Joſeph Mawbey; where are ſeldom leſs than 2000 hogs, which are fed entirely on grains.

113 3. City and Liberties of Weſtminſter.

III. *City and Liberties of* WESTMINSTER. The city of Weſtminſter derives its name from a *minſter*, or abbey, and *weſt*, on account of its ſituation with reſpect to St Paul's cathedral, which was formerly called *Eaſtminſter*. In ancient times this diſtrict ſtood upwards of a mile from the city of London, and contained only two pariſhes, which were thoſe of St Margaret and St John, with two chapels of eaſe; but at preſent it has ſeven other parochial churches, viz. St Clement's Danes, St Paul's Covent garden, St Mary's le Strand, St Martin's in the Field's, St Anne's, St James's, and St George's Hanover-ſquare.

Weſtminſter was anciently called *Thorny Iſland*, from its having been covered with thorn buſhes, and encompaſſed by a branch of the Thames, which is ſaid to have run through the ground now called *St James's Park*, from weſt to eaſt, and to have rejoined the river at Whitehall.

Till the general diſſolution of religious houſes, Weſtminſter was ſubject to the arbitrary rule of its abbot and monks; but in 1541, upon the ſurrender of William Benſon the laſt abbot, Henry VIII. not only turned it into an honour, but created it the ſee of a biſhop, and appointed for a dioceſe the whole county of Middleſex, except Fulham, which belonged to the biſhop of London. This biſhoprick, however, ſoon after its inſtitution, was diſſolved by Edward VI.

114 Government of Weſtminſter.

The city of Weſtminſter is governed by a high ſteward, an office of great dignity, who is uſually one of the firſt peers in the realm; and is choſen for life by the dean and chapter of the collegiate church of St Peter. There is alſo a deputy ſteward and a high bailiff, who alſo hold their offices for life; being nominated by the dean and chapter, and confirmed by the high ſteward.

The dean and chapter are inveſted with an eccleſiaſtical and civil juriſdiction within the liberties of Weſtminſter, St Martin's le Grand, near Cheapſide, in the city of London, and ſome towns in Eſſex, which are exempted from the juriſdiction of the biſhop of London and the archbiſhop of Canterbury.

115 Churches.

St Margaret's Church was founded by Edward the Confeſſor, ſince which time it has been frequently rebuilt. In the eaſt end of this church is a window curiouſly painted, with the hiſtory of the crucifixion, and with the figures of ſeveral apoſtles and ſaints finely executed. It formerly belonged to a private chapel at Copt-hall, near Epping in Eſſex, and was purchaſed by the officers of this pariſh, ſome years ago for 400 guineas. In this church the houſe of commons attends divine ſervice on ſtate holidays.

The *church of St John the Evangeliſt* was erected in 1728, and having ſunk conſiderably whilſt it was building, occaſioned an alteration of the plan. On the north and ſouth ſides are magnificent porticoes, ſupported by vaſt ſtone pillars, as is alſo the roof of the church; at each of the four corners is a beautiful ſtone tower and pinnacle, which were added with the view of making the whole ſtructure ſink equally. The parts of this building are held together by iron bars, which run acroſs even the aiſles.

116 Weſtminſter Abbey, and its Chapels.

The moſt remarkable ſtructure in Weſtminſter is the *abbey-church of St Peter*. On its ſite ſtood once a temple of Apollo, which according to tradition was thrown down by an earthquake in the time of Antoninus Pius; and from the ruins of which Sebert king of the Weſt Saxons raiſed a Chriſtian church, which was ruined by the Danes. It was repaired by Edward the Confeſſor, and given to a few monks; and this ſpot he choſe for his burial-place. Henry III. 160 years after, took down this fabric of Edward's, and erected a new church, which was 50 years in building. It ſuffered much by fire in 1274, but was repaired by Edward I. Edward II. and the abbots. In 1700 this church being much decayed, the parliament granted money for repairing it, and has frequently repeated the bounty ſince that time. The form of the abbey is that of a long croſs:

Frontiniac, to the more elegant tables; the Madeira, the Calcavella, and the Liſbon, into every part of the kingdom."

(L) "There is a magnificence of buſineſs (our author remarks) in this ocean of ſweets and ſours that cannot fail exciting the greateſt admiration; whether we conſider the number of veſſels or their ſize. The boaſted tun at Heidelberg does not ſurpaſs them. On firſt entering the yard, two riſe before you, covered at the top with a thatched dome; between them is a circular turret, including a winding ſtaircaſe, which brings you to their ſummits, which are above 24 feet in diameter. One of theſe conſervatories is full of ſweet wine, and contains 58,109 gallons, or 1815 barrels of Wincheſter meaſure. Its ſuperb aſſociate is full of vinegar, to the amount of 56,799 gallons, or 1774 barrels of the ſame ſtandard as the former. The famous German veſſel yields even to the laſt by the quantity of 40 barrels.—Beſides theſe, is an avenue of leſſer veſſels, which hold from 32,500 to 16,974 gallons each. After quitting this Brobdignagian ſcene, we paſs to the acres covered with common barrels: we cannot diminiſh our ideas ſo ſuddenly, but at firſt we imagine we could quaff them off as eaſily as Gulliver did the little hogſheads of the kingdom of Lilliput."

London. crofs: its greateft length is 489 feet, and the breadth of the weft front 66 feet; the length of the crofs aifle is 189 feet, and the height of the roof 92 feet. At the weft end are two towers: the nave and crofs aifle are fupported by 50 flender pillars of Suffex marble, exclufive of pilafters. In the upper and lower ranges there are 94 windows, all which, with the arches, roofs, and doors, are in the Gothic tafte. The infide of this church is much better executed than the outfide: and the perfpective is good, particularly that of the grand aifle. The choir, from which there is an afcent by feveral fteps to a fine altar-piece, is paved with black and white marble; having 28 ftalls on the north, the fame number on the fouth, and eight at the weft end. The altar is made of a beautiful piece of marble, the gift of Queen Anne, enclofed by a curious baluftrade, and upon a pavement of porphyry, jafper, Lydian, and ferpentine ftones, laid in the mofaic ftyle, at the expence of Abbot Ware, A. D. 1272; and is faid to be one of the moft beautiful of its kind in the world. On each fide of this altar a door opens into St Edward's chapel; round which are 10 other chapels, ranging from the north to the fouth crofs aifles, and are dedicated, 1. To St Andrew. 2. To St Michael. 3. To St John Evangelift. 4. Iflip's chapel. 5. To St John Baptift. 6. To St Paul. 7. Henry V.'s chapel. 8. To St Nicholas. 9. To St Edmund. 10. To St Benedict.

In St Edward's chapel are ftill to be feen the remains of his fhrine; which, though now in obfcurity, and robbed of all its riches and luftre, was once efteemed the glory of England, fo far as art and riches could make it. Here are the tombs of King Edward I. and feveral other kings and queens of England; and here alfo is fhown the famous chair in which the kings of Scotland ufed to be crowned at Scoone. Henry V.'s chapel is divided from St Edward's by an iron fcreen, on each fide of which are ftatues as big as life.—St Andrew's chapel, which is next the north crofs, and the others which furround the choir, are crowded with the monuments of noble perfonages, worthy the attention of the curious.—At the corner of St Benedict's chapel, an iron gate opens into the fouth crofs aifle; which from the number of monuments erected therein to celebrated Englifh poets, has obtained the name of the *Poets corner:* though here we find a moft magnificent monument erected at the fouth end in memory of the late John duke of Argyle and Greenwich; another to William Camden the antiquarian; and others to the celebrated divine Dr Ifaac Barrow, to Thomas Parr who died at the age of 152 years, &c.—The fouth aifle is adorned with 19 curious monuments of the pious, the brave, and the learned; and turning northward from the weft door, we view a great number more.

117 Henry VII.'s chapel. On the eaft of the abbey, and which, though feparate from the other chapels in the choir, feems to be one and the fame building with the abbey, ftands the chapel of King Henry VII. which that king founded in the year 1502, and was at that time ftyled the *wonder of the world*, and is now one of the moft expenfive remains of the ancient Englifh tafte and magnificence. There is no looking upon it without admiration: it conveys an idea of the fine tafte of Gothic architecture in that age; and the infide is fo noble, majeftic, and of fuch curious workmanfhip, that it would take a volume to defcribe each part with juftice and propriety.

Its original intention was to be a dormitory for the royal blood: and fo far the will of the founder has been obferved, that none have been interred therein but fuch as have traced their defcent from ancient kings. The tomb of King Henry VII. is moft magnificent, enclofed with a fcreen of caft brafs, moft admirably defigned, and as well executed. Within the rails are the figures of that king and his royal confort, in their robes of ftate, on a tomb of black marble: and at the head of this tomb lie the remains of Edward VI. In different parts of this chapel are the monuments of Lewis Stuart duke of Richmond, George Villars duke of Buckingham, John Sheffield duke of Buckingham, Charles Montague marquis of Halifax, Edward V. and his brother Richard; the vault of James I. and his queen Anne and daughter Mary, on which is a fmall tomb adorned with the figure of a child; a lofty monument of Queen Elizabeth, and another of Mary queen of Scots; the monuments for Margaret Douglas daughter of Margaret queen of Scots, Margaret countefs of Richmond mother to Henry VII. the vault of King Charles II. and William III. Queen Mary his confort, Queen Anne, and Prince George. Over thefe royal perfonages are their effigies (except that of Prince George) in wainfcot preffes, made of wax to refemble life, and dreffed in their coronation robes. And at the corner of the great eaft window, in another wainfcot prefs, ftands the effigy of Mary duchefs of Richmond, daughter to James duke of Richmond and Lenox, dreffed in the very robes fhe wore at the coronation of Queen Anne. On leaving the aifle, you are fhown another prefs, containing the effigy of General Monk, who, on account of his loyalty, and the part he took in the reftoration of King Charles II. had a vault appropriated to him and his family amongft the royal blood.

In a fine vault under Henry the VII.'s chapel, is the burying place of the prefent royal family, erected by his late majefty King George II. Adjoining to the abbey are the cloifters, built in a quadrangular form, with piazzas towards the court, where feveral of the prebendaries have their houfes.

Near the abbey church is the King's fchool, ufually called *Weftminfter fchool.* It was originally founded in 1070, and a fecond time by Queen Elizabeth in 1560, whence it is fometimes called the *Queen's College;* and is at prefent one of the greateft fchools in the kingdom. The learned antiquary Mr Camden was once mafter of it, and Ben Johnfon one of his fcholars. Dr Bufby, who was mafter upwards of 50 years, greatly contributed to keep up its reputation, formed its mufeum, and improved both the mafter's and his prebendal houfe.—This fchool, inftead of one mafter and one ufher as at firft, has now an upper and under mafter, and five ufhers, who have about 400 youths under their tuition. A plan was fet on foot when the prefent archbifhop of York was mafter, for building a college for the ufe of the ftudents, but this did not fucceed. 118 Weftminfter School.

On the north-eaft fide of the abbey is an old Gothic building called *Weftminfter-hall*, firft built by William Rufus as an addition to a royal palace, and afterwards 119 Weftminfter-hall.

London. wards rebuilt by Richard II. in the year 1397. It is reckoned one of the largeſt rooms in Europe, being 200 feet long, 70 broad, and 90 high, ſupported only by buttreſſes. The roof is of timber, and was ſome years ago ſlated, the old covering of lead being reckoned too heavy. It is paved with ſtone. In this ſpacious room the kings of England have generally held their coronation and other ſolemn feaſts; and it is uſed for the trial of peers. Since the reign of Henry III. the three great courts of Chancery, King's Bench, and Common Pleas, have been held in ſeparate apartments of this hall; and the court of Exchequer above ſtairs.

120 Houſe of Commons. Adjoining to the ſouth-eaſt angle of Weſtminſter-hall is a building formerly called *St Stephen's Chapel*, from its having been dedicated to that ſaint. It was founded by King Stephen; and in 1347 was rebuilt by King Edward III. who converted it to a collegiate church; but ſince it was ſurrendered to Edward VI. it has been uſed for the aſſembly of the repreſentatives of the commons of England, and is now generally called the *Houſe of Commons*. The benches, which aſcend behind one another as in a theatre, are covered with green cloth; the floor is matted; and round the room are wainſcot galleries, ſupported by cantilevers adorned with carved work, in which ſtrangers are often permitted to ſit and hear the debates.

121 Houſe of Lords. On the ſouth ſide of the hall is the *Houſe of Lords*, ſo called from being the place where the peers of Great Britain aſſemble in parliament. It is an oblong room, not quite ſo large as the houſe of commons; and is hung with fine old tapeſtry, repreſenting the defeat of the Spaniſh Armada in 1588. The deſign was drawn by Cornelius Vroom, and the tapeſtry executed by Francis Spiering. It was not put up till the year 1650, two years after the extinction of monarchy, when the houſe of lords was uſed as a committee room for the houſe of commons. The heads of the naval heroes who commanded on the glorious day form a matchleſs border round the work, animating poſterity to emulate their illuſtrious example. Here is a throne for the king, with ſeats on the right and left for ſuch peers of the realm as are of the blood royal. Before the throne are three broad ſeats; on the firſt of which, next the throne, ſits the lord chancellor, or keeper of the great ſeal, who is ſpeaker of the houſe of peers; and on the other two ſit the judges, the maſter of the rolls, or the maſters in chancery, who attend occaſionally to give their opinions on points of law. The two archbiſhops ſit at ſome diſtance from the throne on the right hand, and the other biſhops in a row under them. All the benches are covered with red cloth ſtuffed with wool. Here likewiſe, by an order of the houſe, a gallery for ſtrangers has been erected.

122 Prince's Chamber, &c. Adjoining to the houſe of lords is the *Prince's Chamber*, where the king is robed when he comes to the parliament. On the other ſide is the *Painted Chamber*, which is ſaid to have been Edward the Confeſſor's bedchamber, and the room in which the parliaments were anciently opened. Here conferences are often held between the two houſes, or their committees. Contiguous to thoſe is an apartment called the *Court of Requeſts*, where ſuch as have buſineſs in either houſe may attend.

Near theſe buildings is a bridge over the Thames, called *Weſtminſter Bridge*, accounted one of the moſt complete and elegant ſtructures of the kind in the known world. It is built entirely of ſtone, and extends over the river at a place where it is 1223 feet broad: which is above 380 feet broader than at London bridge. On each ſide is a fine baluſtrade of ſtone, with places of ſhelter from the rain. The width of the bridge is 44 feet, having on each ſide a fine foot way for paſſengers. It conſiſts of 14 piers, and 13 large and two ſmall arches, all ſemicircular, that in the centre being 76 feet wide, and the reſt decreaſing four feet each from the other, ſo that the two leaſt arches of the 13 great ones are each 52 feet. It is computed that the value of 40,000l. in ſtone and other materials is always under water. This magnificent ſtructure was begun in 1739, and finiſhed in 1750, at the expence of 389,000l. defrayed by the parliament. It was built after the deſign of M. Labelye, an ingenious architect, a native of France. London. 123 Weſtminſter Bridge.

On the bank of the Thames, at the eaſt confines of St Margaret's pariſh, was a palace called *Whitehall*, originally built by Hubert de Burgh earl of Kent, before the middle of the 13th century. It afterwards devolved to the archbiſhop of York, whence it received the name of *York Place*, and continued to be the city reſidence of the archbiſhops till it was purchaſed by Henry VIII. of Cardinal Wolſey in 1530. At this period it became the reſidence of the court; but in 1697 was deſtroyed by accidental fire, all except the Banqueting-houſe, which had been added to the palace of Whitehall by James I. according to a deſign of Inigo Jones. This is an elegant and magnificent ſtructure of hewn ſtone, adorned with an upper and lower range of pillars, of the Ionic and Compoſite orders; the capitals are enriched with fruit and foliages, and between the columns of the windows. The roof is covered with lead, and ſurrounded with a baluſtrade. The building chiefly conſiſts of one room of an oblong form 40 feet high, and a proportionable length and breadth. The cieling is painted by the celebrated Sir Peter Paul Rubens. It is now uſed only as a chapel-royal, and the other part of the houſe is occupied with with ſtate offices. 124 Whitehall.

Oppoſite to the Banqueting-houſe ſtands the *Horſe Guards*, ſo called from being the ſtation where that part of his majeſty's troops uſually do duty. It is a ſtrong building, of hewn ſtone, conſiſting of a centre and two wings. In the former is an arched paſſage into St James's Park; and over it, in the middle, riſes a cupola. In a part of the building is the War Office. Near the Horſe-guards is the *Treaſury;* a large building, which fronts the Parade in St James's park; and where the board of treaſury is kept. 125 Horſe Guards.

Eaſtward of the Horſe Guards is the *Admiralty Office*, a large pile, built with brick and ſtone. The front towards Whitehall has two deep wings, and a lofty portico ſupported by four large ſtone pillars. A piazza, conſiſting of beautiful columns, runs almoſt from one end to the other. The wall before the court has been lately built in an elegant manner, and each ſide of the gate is ornamented with naval emblems. Beſides a hall, and other public apartments, here are ſpacious houſes for ſeven commiſſioners of the admiralty. 126 Admiralty Office.

At a little diſtance from the Admiralty, where three

London. capital ſtreets terminate, is a large opening called *Charing-croſs*, from one of the croſſes which King Ed-
127 Charing-croſs. ward I. cauſed to be erected in memory of his queen Eleanor, and *Charing* the name of a village in which it was built. The croſs remained till the civil wars in the reign of Charles I. when it was deſtroyed by the fanatics, as a monument of popiſh ſuperſtition; but after the Reſtoration, an equeſtrian ſtatue of Charles I. was ſet up in its ſtead. This, which is of braſs, and finely executed, continues to be an ornament to the place. It was made in 1633, at the expence of the Howard-Arundel family. The parliament ſold it to a brazier in Holborn, with ſtrict orders to break it to pieces; but he concealed it under ground till the Reſtoration, when it was ſet up in 1678.

128 Queen's Palace. At the weſt end of the Mall, in St James's park, which begins near Charing-croſs, ſtands the *Queen's Palace*. It was originally known by the name of *Arlington Houſe;* but being purchaſed by the late duke of Buckingham's father, who rebuilt it from the ground in 1703, it was called *Buckingham Houſe*, till the year 1762, when it was purchaſed by his majeſty for a royal reſidence. It is built of brick and ſtone, having in the front two ranges of pilaſters of the Corinthian and Tuſcan orders. It has a ſpacious court yard, encloſed with iron rails, fronting St James's park, with offices on each ſide, with two pavilions, ſeparated from the manſion houſe by colonnades of the Tuſcan, Doric, and Ionic orders. His majeſty has here built a fine library, in an octagonal form, beſides ſeveral other additions.

129 St James's. Eaſtwards of the queen's palace ſtands *St James's*, an old building, which, till the former was purchaſed by the crown, had been the town reſidence of the royal family ſince the burning of Whitehall in 1697. This palace was built by Henry VIII. and obtained its name from an hoſpital which formerly ſtood on the ſpot. It is an irregular building, of a mean appearance without, but contains ſeveral magnificent apartments. Here the court and levees are ſtill kept, and moſt of the perſons belonging to the houſehold have their reſidence. The chapel of the hoſpital was converted to the uſe of the royal family, as it now remains, and is a royal peculiar, exempted from all epiſcopal juriſdic-
130 The Park and Mall. tion. When this palace was built, it abutted in the ſouth-weſt upon an uncultivated ſwampy tract of ground, which the king encloſed and converted into a park, called from the palace *St James's park*. He alſo laid it out into walks, and collected the water into one body. It was afterwards much enlarged and improved by King Charles II. who planted it with lime trees, and formed a beautiful viſta, near half a mile in length, called the *Mall*, from its being adapted to a play at bowls diſtinguiſhed by that name. He alſo formed the water into a canal 100 feet broad and 2800 feet long; and furniſhed the park with a decoy, and other ponds for water-fowl; but theſe have lately been deſtroyed, on account of the unwholeſome vapours which they excited.

In a line with St James's palace, on the eaſt ſide, is *Marlborough-houſe*, which belongs to the duke of Marlborough, and is a large brick edifice, ornamented with ſtone.

131 The Strand, when firſt formed. Eaſtward from Charing-croſs, runs that fine ſtreet the *Strand*, which terminates at Temple-bar. In the year 1353 the whole of it was an open high way, with gardens to the water-ſide. In that year it was ſo ruinous, that Edward III. by an ordinance directed a tax to be raiſed upon wool, leather, wine, and goods carried to the ſtaple at Weſtminſter, from Temple-bar to Weſtminſter abbey, for the repair of the road; and that all owners of houſes adjacent to the high way ſhould repair as much as lay before their doors. Before the above period, it entirely cut off Weſtminſter from London; nothing intervened except the ſcattered houſes, and a village which afterwards gave name to the whole; and St Martin's ſtood literally in the fields. But about the year 1560 a ſtreet was formed, looſely built; for all the houſes on the ſouth ſide had great gardens to the river, were called by their owners names, and in after-times gave name to the ſeveral ſtreets that ſucceeded them, pointing down to the Thames; each of them had ſtairs for the conveniency of taking boat, of which many to this day bear the names of the houſes. As the court was for centuries either at the palace of Weſtminſter or Whitehall, a boat was the cuſtomary conveyance of the great to the preſence of their ſovereign. The north ſide was a mere line of houſes from Charing-croſs to Temple-bar; all beyond was country. The gardens which occupied part of the ſite of Covent-garden were bounded by fields, and St Giles's was a diſtant country village. Our capital found itſelf ſo ſecure in the vigorous government of Queen Elizabeth, that, by the year 1600, moſt conſiderable additions were made to the north of the long line of ſtreet juſt deſcribed. St Martin's-lane was built on both ſides. St Giles's church was ſtill inſulated: but Broad-ſtreet and Holborn were completely formed into ſtreets with houſes all the way to Snow-hill. Covent-garden and Lincoln's-inn-fields were built, but in an irregular manner. Drury-lane, Clare-ſtreet, and Long-acre, aroſe in the ſame period.

Almoſt contiguous to Charing-croſs, and upon the ſouth ſide of the Strand, is that noble palace called *Northumberland Houſe*, which ſtands on the ſite of the hoſpital of St Mary Rounceval. Henry VIII. granted it to Sir Thomas Caverden. It was afterwards transferred to Henry Howard earl of Northampton; who, in the time of James I. built here a houſe, and called it after his own name. He left it to his kinſman the earl of Suffolk, lord treaſurer: and by the marriage of Algernon Percy earl of Northumberland, with Elizabeth daughter of Theophilus earl of Suffolk, it paſſed into the houſe of the preſent noble owner. The greater part of the houſe was built by Bernard Janſen, an architect in the reign of James I. The front next the ſtreet was begun by Algernon in 1748, and finiſhed by the preſent duke, who married his daughter. Two additional wings to the front next the Thames, and a variety of other improvements both in building and furniture, have contributed to render this houſe the largeſt and moſt magnificent in London. It contains a gallery of 106 feet long by 26 wide, moſt ſuperbly furniſhed. 132 Northumberland Houſe.

A ſhort way eaſtward, on the ſame ſide, ſtood *Durham Yard*, which took its name from a palace built originally by the illuſtrious Thomas de Hatfield, elected biſhop of Durham in 1345; deſigned by him for the town reſidence of him and his ſucceſſors. At this place, in 133 Durham Yard.

in 1540, was held a moſt magnificent feaſt, given by the challengers of England, who had cauſed to be proclaimed, in France, Flanders, Scotland, and Spain, a great and triumphant juſting to be holden at Weſtminſter, for all comers that would undertake them. But both the challengers and defendants were Engliſh. After the gallant ſports of each day, the challengers rode into this Durham-houſe where they kept open houſehold, and feaſted the king and queen (Anne of Cleves) with her ladies, and all the court. In the reign of Edward VI. the Mint was eſtabliſhed in this houſe, under the management of Sir William Sharrington, and the influence of the aſpiring Thomas Seymour, lord admiral. Durham-houſe was reckoned one of the royal palaces belonging to Queen Elizabeth; who gave the uſe of it to the great Sir Walter Raleigh.

134 The Adelphi. Durham-yard is now filled with a moſt magnificent maſs of building, called the *Adelphi*, in honour of two brothers, the ingenious Adams, its architects. Beſides its fine lodgings, it is celebrated for its enchanting proſpect, the utility of its wharfs, and its ſubterraneous apartments anſwering a variety of purpoſes of general benefit.

135 The Savoy. Farther on ſtand the ruins of the *Savoy*. Henry III. had granted to Peter of Savoy, uncle to his queen Eleanor, daughter of Berringer of Provence, all the houſes upon the Thames where this building now ſtands, to hold to him and his heirs, yielding yearly at the Exchequer three barbed arrows for all ſervices. This prince founded the Savoy, and beſtowed it on the foreign hoſpital of Montjoy. Queen Eleanor purchaſed it, and beſtowed it on her ſon Edmund earl of Lancaſter. It was rebuilt in a moſt magnificent manner by his ſon Henry. It was made the place of confinement of John king of France in 1356, after he was taken priſoner at the battle of Poitiers. In 1381 it was entirely deſtroyed by Wat Tyler, out of ſpleen to the great owner John of Gaunt. Henry VII. began to rebuild it, with a deſign of forming it into an hoſpital for a hundred diſtreſſed people, and Henry VIII. completed the deſign. The revenues, at the ſuppreſſion by Edward VI. amounted to above 500l. a-year. Queen Mary reſtored it; and her maids of honour, with exemplary piety, furniſhed it with all neceſſaries. It was again ſuppreſſed by Queen Elizabeth; and at preſent part ſerves as lodgings for private people, for barracks, and a ſcandalous infectious priſon for the ſoldiery and for tranſport-convicts.

136 Somerſet Houſe. A little to the eaſtward ſtood *Somerſet Houſe*, a palace built by Somerſet the protector in the time of Edward VI.; and to make way for which he demoliſhed a great number of buildings without making any recompenſe to the owners. Part of the church of St John of Jeruſalem and the Tower were blown up for the ſake of the materials; and the cloiſters on the north ſide of St Paul's, with the charnel-houſe and chapel, underwent the ſame fate; the tombs being deſtroyed, and the bones thrown into Finſbury-fields. This happened in 1549; but it is probable that he did not live to inhabit the palace he built, as he was executed in the year 1552 After his death the palace fell to the crown; and it became an occaſional place of reſidence, firſt to Queen Elizabeth, and afterwards to Catherine queen to King Charles II. It was built in a ſtyle of architecture compounded of the Grecian and Gothic; and the back, front, and water-gate, were done from a deſign of Inigo Jones, about the year 1623. A chapel was begun the ſame year by that architect, and finiſhed ſome time after. The whole of this ſtructure was demoliſhed in 1775, in conſequence of an act of parliament; and a moſt magnificent edifice, from a deſign by Sir William Chambers, has been erected for the accommodation of all the public offices,—thoſe of the Treaſury, the Secretary of State, the Admiralty, the War, and the Exciſe, excepted. The Royal Society, and the Society of Antiquarians, hold their meetings here, in apartments which have been allotted to them by royal munificence; and here alſo are annually exhibited the works of the Britiſh painters and ſculptors. The terrace on the ſouth ſide is a walk bounded by the Thames, and unparalleled for grandeur and beauty of view.

The church of St Martin is diſtinguiſhed by the name of *St Martin's in the Fields*, from its ſituation, which was formerly a field, with only a few ſcattered houſes. The church being decayed, was rebuilt by Henry VIII. and again by James I. but not being large enough to accommodate the inhabitants of the pariſh, it was augmented in 1607, at the charge of Prince Henry, eldeſt ſon of James I. and ſeveral of the nobility. After many expenſive reparations, however, it was entirely taken down in 1720, and a new church begun, which was finiſhed in 1726. This is an elegant edifice, built of ſtone. On the weſt front is a noble portico of Corinthian columns, ſupporting a pediment, in which are repreſented the royal arms in bas relief. The aſcent to the portico is by a flight of very long ſteps. The length of this church is about 140 feet, the breadth 60, and height 45. It has a fine arched roof ſuſtained by ſtone columns of the Corinthian order. The ſteeple has a beautiful ſpire, and one of the beſt rings of bells in London. 137 St Martin's and other Churches.

St James's Church was built in the reign of Charles II. at the expence of Henry earl of St Alban's, and other neighbouring inhabitants. The building is of brick and ſtone, about 85 feet long, 60 broad, and 45 feet high, with a handſome ſteeple 150 feet in height.

St George's Church, near Hanover-ſquare, is a beautiful ſtructure. This was one of the fifty new churches erected within the reign of Queen Anne. The ground for the edifice was given by the late Lieutenant-general Stewart, who alſo left 4000l. to the pariſh, towards erecting and endowing a charity ſchool; which, by additional benefactions and ſubſcriptions, is become very conſiderable.

The greater part of the pariſh of *St Paul's Covent-garden*, was anciently a garden, belonging to the abbot and convent of Weſtminſter, and was then called *Convent-garden*, a name corrupted into Covent, and more generally Common-garden. In 1552, Edward VI. gave it to the earl of Bedford, with an adjoining field, formerly called the *Seven Acres*, but now, being turned into a long ſtreet, called *Long-acre*. The church of St Paul's, Covent-garden, was built by Inigo Jones, and was eſteemed one of the moſt ſimple and perfect pieces of architecture in England. It was burnt by accident a few years ago; but has ſince been rebuilt in a very plain ſtile. In the area before the church, of about 138 Covent Garden.

London. three acres of ground, is *Covent garden market*, which is the beſt in England for herbs, fruit, and flowers. On the north, and part of the eaſt ſide, is a magnificent piazza, deſigned by Inigo Jones.

139 St Mary le Strand, &c. Next to the pariſh of St Paul, Covent-garden, is that of *St Mary le Strand*. This is alſo one of the fifty new churches built in the reign of Queen Anne, and is a handſome piece of architecture, though not very extenſive. At the entrance, on the weſt ſide, is an aſcent by a flight of ſteps, in a circular form, which leads to a ſimilarly ſhaped portico of Ionic columns, covered with a dome, that is crowned with a vaſe. The columns are continued along the body of the church, with pilaſters of the ſame order at the corners; and in the intercolumniations are niches handſomely ornamented. Over the dome is a pediment ſupported by Corinthian columns, which are alſo continued round the body of the ſtructure, over thoſe of the Ionic order. A handſome baluſtrade is carried round the top of the church, and adorned with vaſes.

A little eaſtward from the preceding church is that of *St Clement's Danes*, ſituated likewiſe in the Strand. A church is ſaid to have ſtood in this place ſince about the year 700; but the preſent ſtructure was begun in 1680, deſigned by Sir Chriſtopher Wren. It is built of ſtone, with two rows of windows, the lower plain, but the upper ornamented; and the termination is by an attic, the pilaſters of which are covered with vaſes. On the ſouth ſide is a portico, covered with a dome ſupported by Ionic columns; and oppoſite to this is another. The ſteeple is beautiful, and of a great height.

The *church of St George*, Bloomſbury, is alſo one of the fifty new churches erected by act of parliament. It is diſtinguiſhed from all the reſt by ſtanding ſouth and north, and by the ſtatue of King George I. at the top of its pyramidal ſteeple.

140 Foundling and other Hoſpitals. In Lamb's Conduit-fields, on the north ſide of the town, is a large and commodious ſtructure called the *Foundling Hoſpital*, for the reception of expoſed and deſerted children. This laudable charity was projected by ſeveral eminent merchants in the reign of Queen Anne; but was not carried into execution till many years afterwards, when a charter for its eſtabliſhment was obtained, through the indefatigable aſſiduity of Mr Thomas Coram, the commander of a merchant veſſel, who ſpent the remainder of his life in promoting this deſign. From the time of its inſtitution, the parliament has occaſionally granted conſiderable ſums for its ſupport; and in ſome years upwards of 6000 infants have been received.

Not far from hence is an *Hoſpital for the Smallpox*; and in different parts of the town there are others, either for the ſick of all kinds, or thoſe in particular circumſtances. Of the latter are ſeveral *Lying-in hoſpitals*, and the *Lock Hoſpital* for female patients in the venereal diſeaſe. Of the former are *St George's* and *Middleſex Hoſpitals*, beſides ſeveral infirmaries.

141 Gray's Inn. *Gray's Inn* is one of the four principal inns of court; which, though ſituated within the limits of the pariſh of St Andrew, Holborn, is yet without the liberties of the city of London. It took its name from an ancient family of the name of Gray, which formerly reſided here, and in the reign of Edward III. demiſed it to ſome ſtudents in the law; but it is ſaid to have been afterwards conveyed to the monks of Shene, near Richmond in Surry, who leaſed it to the ſociety of the Inn. It was held by this tenure till the diſſolution of the monaſteries, when Henry VIII. granted it to the ſociety in fee-farm. This inn conſiſts chiefly of two quadrangles, and has an old hall well built of timber, with a chapel in the Gothic ſtyle. Here is alſo a good library, and the inn is accommodated with a ſpacious garden. London.

Lincoln's Inn, another of the four principal inns of court, was originally the palace of Ralph Neville biſhop of Chicheſter, and chancellor of England about the year 1226. It afterwards devolved to the earl of Lincoln, who converted it into a court for the ſtudents of law about the year 1310. From him it received the name of *Lincoln's Inn*, and conſiſted only of what is now called the old ſquare, which is entered from Chancery-lane. At preſent this ſquare contains, beſides buildings for the lawyers, a large hall where the lord chancellor hears cauſes in the ſittings after term. To this inn belongs likewiſe a fine garden, which has lately been diminiſhed by the building of ſome large and commodious offices, for the uſe of the ſix clerks in the court of chancery, &c. 142 Lincoln's Inn.

In the pariſh of St James, Clerkenwell, is an hoſpital called the *Charter-houſe*, which is a corruption of the word *chartreux*, a name formerly uſed for a convent or priory of the Carthuſians, which this place formerly was. After the diſſolution of monaſteries it fell to the earl of Suffolk, who diſpoſed of it to Thomas Sutton, Eſq. a citizen of London, in the time of King James I. for 13,000l. The purchaſer intending it for an hoſpital, applied to the king for a patent, which he obtained in 1611, and the grant was confirmed by parliament in 1623. Mr Sutton having expended 7000l. in fitting up the buildings, gave it the name of *King James's Hoſpital*, and endowed it with lands to the amount of near 4500l. a-year, for the maintenance of 80 gentlemen, merchants or ſoldiers, who ſhould be reduced to indigent circumſtances; and 40 boys, to be inſtructed in claſſical learning. The men are provided with handſome apartments, and all the neceſſaries of life except clothes; inſtead of which each of them is allowed a gown, and 7l. a-year. Of the boys, 29 are at a proper time ſent to the univerſity, where each has an allowance of 20l. a-year for eight years. Others, who are judged more fit for trade, are put out apprentices, and the ſum of 40l. is given with each of them. As a farther encouragement to the ſcholars, there are nine eccleſiaſtical preferments in the gift of the governors. It is alſo by the recommendation of the latter that all penſioners and youths are received into the hoſpital. They conſiſt of 16, of which number the king is always one, and the others are generally noblemen of the firſt rank. To this hoſpital belong a maſter, a preacher, two ſchoolmaſters, a phyſician, a regiſter, a receiver, a treaſurer, a ſteward, an auditor, and other officers; and the annual revenues of it being now increaſed to upwards of 6000l. five men and four boys have been added to the original number. 143 Charter houſe.

In the pariſh of St Luke ſtands the Haberdaſhers alms-houſe, or *Aſke's Hoſpital*, ſo called from having been erected by the company of haberdaſhers, purſuant to the will of Robert Aſke, Eſq; one of their members, 144 Aſke's Hoſpital.

London. bers, who left 30,000l. for the building and the relief of 20 poor members of the company; beſides the maintenance and education of 20 boys, ſons of decayed freemen of the ſame company. This is a large edifice of brick and ſtone, 400 feet long, with a piazza in front 340 feet in length, conſiſting of ſtone columns of the Tuſcan order. In the middle of the building is a chapel, adorned with columns, entablatures and pediment, of the Ionic order; under the pediment is a niche with a ſtatue of the founder. In the ſame pariſh is the Ironmongers hoſpital, likewiſe a large building.

In the pariſh of St Mary, Whitechapel, ſtands the *London Hoſpital*, for the reception of the ſick. It is a large building, and was erected a few years ſince by voluntary contribution. Here are alſo ſome conſiderable alms-houſes.

145 Houſes of the nobility. Within the precincts of Weſtminſter are ſeveral ſtately houſes belonging to the nobility, ſome of which have been already mentioned. Of the others, the moſt remarkable at preſent are, Burlington-houſe, Devonſhire-houſe, Egremont-houſe, and Bedford-houſe; Carleton-houſe, the magnificent abode of the prince of Wales; and the ſuperb reſidence erected by the duke of York between the Treaſury and the Horſe-guards.

146 Britiſh Muſeum. To theſe may be added, *Montagu-houſe* (now the Britiſh Muſeum); which was built on a French plan by the firſt duke of Montagu, who had been ambaſſador in France. The ſtaircaſe and ceilings were painted by Rouſſeau and La Foſſe: the apotheoſis of Iris, and the aſſembly of the gods, are by the laſt. It was purchaſed of the duke's heirs by parliament, for uniting together the Royal, Cottonian, Harleian, Sloanian, and other collections of books, MSS. coins, antiquities, ſubjects in natural hiſtory, &c. &c. for the public uſe, for which it is excellently adapted. The firſt of theſe libraries contains the books and MSS. of our princes from Henry VII. to Charles II.; the ſecond the MSS. collected by Sir John Cotton, his ſon, and grandſon Sir John, which laſt gave it to the public by act 12 and 13 William III. c. 7. The Harleian collection of MSS. was formed by Edward earl of Oxford, and purchaſed by government in 1753, at the ſame time with the library, MSS. and natural curioſities, of Sir Hans Sloane. This laſt coſt Sir Hans 50,000l.; and he left it by will, to the uſe of the public, on condition that the parliament would pay 20,000l. to his executors. It comprehends an amazing number of curioſities: among which are, the library, including books of drawings, MSS. and prints, amounting to about 50,000 volumes; medals and coins, ancient and modern, 20,000; cameos and intaglios, about 700; ſeals, 268; veſſels, &c. of agate, jaſper, &c. 542; antiquities, 1125; precious ſtones, agates, jaſper, &c. 2256; metals, minerals, ores, &c. 2725; cryſtal, ſpars, &c, 1864; foſſils, flints, ſtones, 1275; earths, ſands, ſalts, 1035; bitumens, ſulphurs, ambers, &c. 399; talcs, micæ, &c. 388; corals, ſponges, &c. 1421; teſtacea, or ſhells, &c. 5843; echini, echinitæ, &c. 659; aſteriæ, trochi, entrochi, &c. 241; cruſtaceæ, crabs, lobſters, &c. 363; ſtellæ marinæ, ſtar-fiſhes, &c. 173; fiſh, and their parts, &c. 1555; birds, and their parts, eggs, and neſts of different ſpecies, 1172; quadrupeds, &c. 1886; vipers, ſerpents, &c. 521; inſects, &c. 5439; vegetables, 12,506; hortus ſiccus or volumes of dried plants, 334; humani, as calculi, London. anatomical preparations, 756; miſcellaneous things, natural, 2098; mathematical inſtruments, 55. A catalogue of all the above is written in a number of large volumes. It is a large and magnificent building; and has behind it a garden, conſiſting nearly of nine acres.

The Britiſh Muſeum has of late been very much enriched by an acceſſion of Egyptian curioſities, chiefly taken from General Menou at Alexandria. In the mean time they are laid in the court-yard, but will ſoon be depoſited in a building which is to be erected for that partiular purpoſe.

Beſides a great number of ſpacious ſtreets, which are daily increaſing, this part of the metropolis is ornamented with ſeveral magnificent ſquares, viz. Groſvenor-ſquare, Berkeley-ſquare, Portman-ſquare, Cavendiſh-ſquare, Hanover-ſquare, St James's-ſquare, Soho-ſquare, Bloomſbury-ſquare, Queen's-ſquare, Lincoln's-Inn-Fields, Leiceſter-ſquare, Red-Lion-ſquare, ſome of which have been particularly deſcribed; not to mention others that are at preſent building. In general, the new buildings in the liberty of Weſtminſter have increaſed to a prodigious degree; inſomuch that they reach as far as Marybone to the north, Piccadilly to the ſouth, and Hyde-Park wall to the weſt. 147 Principal ſquares, &c.

Before the conflagration in 1666, LONDON (which like moſt other great cities, had ariſen from ſmall beginnings) was totally inelegant, inconvenient, and unhealthy, of which latter misfortune many melancholy proofs are authenticated in hiſtory, and which, without doubt, proceeded from the narrowneſs of the ſtreets, and the unaccountable projections of the buildings, that confined the putrid air, and joined with other circumſtances, ſuch as the want of water, rendered the city ſeldom free from peſtilential devaſtation. The fire which conſumed the greateſt part of the city, dreadful as it was to the inhabitants at that time, was productive of conſequences which made ample amends for the loſſes ſuſtained by individuals; a new city aroſe on the ruins of the old; but, though more regular, open, convenient, and healthful, than the former, yet it by no means anſwered to the characters of magnificence or elegance, in many particulars; and it is ever to be lamented (ſuch was the infatuation of thoſe times), that the magnificent, elegant, and uſeful plan of the great Sir Chriſtopher Wren, was totally diſregarded, and ſacrificed to the mean and ſelfiſh views of private property; views which did irreparable injury to the citizens themſelves and to the nation in general: for had that great architect's plan been followed, what has often been aſſerted muſt have been the reſult; the metropolis of this kingdom would inconteſtably have been the moſt magnificent and elegant city in the univerſe; and of conſequence muſt, from the prodigious reſort of foreigners of diſtinction and taſte who would have viſited it, have become an inexhauſtible fund of riches to this nation. But as the deplorable blindneſs of that age has deprived us of ſo valuable an acquiſition, it is become abſolutely neceſſary that ſome efforts ſhould be made to render the preſent plan in a greater degree anſwerable to the character of the richeſt and moſt powerful people in the world. 148 London anciently inconvenient and unhealthy.

The plan of London, in its preſent ſtate, will in many inſtances appear to very moderate judges to be 149 Its plan ſtill defective.

London. as injudicious a difpofition as can eafily be conceived for a city of trade and commerce, on the borders of fo noble a river as the Thames. The wharfs and quays on its banks are extremely mean and inconvenient; and the want of regularity and uniformity in the ftreets of the city of London, and the mean avenues to many parts of it, are alfo circumftances that greatly leffen the grandeur of its appearance. Many of the churches and other public buildings are likewife thruft up in corners, in fuch a manner as might tempt foreigners to believe that they were defigned to be concealed. The improvements of the city of London for fome years paft have, however, been very great; and the new ftreets, which are numerous, are in general more fpacious, and built with greater regularity and elegance.

150 Great improvements. The very elegant and neceffary method of paving and enlightening the ftreets is alfo felt in the moft fenfible manner by all ranks and degrees of people. The roads are continued for feveral miles around upon the fame model; and, exclufive of lamps regularly placed on each fide, at fhort diftances, are rendered more fecure by watchmen ftationed within call of each other. Nothing can appear more brilliant than thofe lights when viewed at a diftance, efpecially where the roads run acrofs; and even the principal ftreets, fuch as Pall-Mall, New Bond-ftreet, Oxford ftreet, &c. convey an idea of elegance and grandeur.

151 Wealth and grandeur of this vaft metropolis. London, then, in its large fenfe, including Weftminfter, Southwark, and part of Middlefex, forms one great metropolis, of vaft extent and of prodigious wealth. When confidered with all its advantages, it is now what ancient Rome once was; the feat of liberty, the encourager of arts, and the admiration of the whole world. It is the centre of trade; has an intimate connexion with all the counties in the kingdom; and is the grand mart of the nation, to which all parts fend their commodities, from whence they are again fent back into every town in the nation and to every part of the world. From hence innumerable carriages by land and water are conftantly employed: and from hence arifes that circulation in the national body which renders every part healthful, vigorous, and in a profperous condition; a circulation that is equally beneficial to the head and the moft diftant members. Merchants are here as rich as noblemen; witnefs their incredible loans to government: and there is no place in the world where the fhops of tradefmen make fuch a noble and elegant appearance, or are better ftocked.

152 Its excellent fituation for commerce. The Thames, on the banks of which London is fituated, is a river which, though not the largeft, is the richeft and moft commodious for commerce of any in the world. It is continually filled with fleets, failing to or from the moft diftant climates; and its banks, from London-bridge to Blackwall, form almoft one continued great magazine of naval ftores; containing numerous wet docks, dry docks, and yards for the building of fhips, for the ufe of the merchants; befides the places alloted for the building of boats and lighters, and the king's yards lower down the river for the building of men of war.

The Weft India Docks are defigned to receive all the fhips trading to the Weft Indies, and will, when finifhed, juftly claim a place among the curiofities of Great Britain. By virtue of an act of parliament they were undertaken in 1799, the entrances into which are by Blackwall and Limehoufe-hole. The proprietors began with a capital of 500,000l. with parliamentary authority to increafe it to 600,000l. if they fhould find it requifite, and they are to be indemnified by a tonnage of 6s. upon the burden of every fhip entering the dock.

The docks at Wapping muft be allowed to be an important improvement. The prodigious one which goes by the name of St George's dock, is capable of containing 200 fhips, and Shadwell dock will contain about 50 veffels. The company projecting and carrying thefe into execution, poffefs a capital of 1,200,000l. and the fhares bear a premium. The foundation of the entrance bafon was laid on the 26th of June, 1802, and at the fame time the firft ftone of a tobacco warehoufe, which is the largeft in the world.

As the city is about 60 miles diftant from the fea, it enjoys, by means of this beautiful river, all the benefits of navigation, without the danger of being furprifed by foreign fleets, or of being annoyed by the moift vapours of the fea. It rifes regularly from the water fide, and, extending itfelf on both fides along its banks, reaches a prodigious length from eaft to weft in a kind of amphitheatre towards the north, and is continued for near 20 miles on all fides, in a fucceffion of magnificent villas and populous villages, the country-feats of gentlemen and tradefmen; whither the latter retire for the benefit of frefh air, and to relax their minds from the hurry of bufinefs. The regard paid by the legiflature to the property of the fubject, has hitherto prevented any bounds being fixed for its extenfion.

The irregular form of London makes it difficult to afcertain its extent. However, its length from eaft to weft is generally allowed to be above feven miles from Hyde-park corner to Poplar; and its breadth in fome places three, in others two, and in others again not much above half a mile. Hence the circumference of the whole is almoft 18 miles; or, according to a later meafurement, the extent of continued buildings is 35 miles two furlongs and 39 roods. But it is much eafier to form an idea of the large extent of a city fo irregularly built by the number of the people, who are computed to be near a million; and from the number of edifices devoted to the fervice of religion. 153 Its great extent.

Of thefe, befide St Paul's cathedral and the collegiate church at Weftminfter, there are 114 parifh-churches and 62 chapels, of the eftablifhed religion; 17 foreign Proteftant chapels; 11 chapels belonging to the Germans, Dutch, Danes, &c.; 26 Independent meetings; 34 Prefbyterian meetings; 20 Baptift meetings; 11 Popifh chapels, and meeting-houfes for the ufe of foreign ambaffadors and people of various fects; and 6 Jews fynagogues. So that there are above 300 places devoted to religious worfhip in the compafs of this vaft pile of buildings, without reckoning the 21 out-parifhes ufually included in the bills of mortality, and a great number of Methodift tabernacles. 154 General enumeration of churches, chapels, &c.

There are alfo in and near this city 100 alms-houfes, about 20 hofpitals and infirmaries, 3 colleges, 10 public prifons, 15 flefh-markets; one market for live cattle; two other markets more particularly for herbs; and 23 other markets for corn, coals, hay, &c.; 15 inns of court; 155 Hofpitals, fchools, houfes, &c.

London.

court; 27 public ſquares, beſides thoſe within ſingle buildings, as the Temple, &c. 3 bridges, 55 halls for companies, 8 public ſchools, called free-ſchools; and 131 charity-ſchools, which provide education for 5034 poor children; 207 inns, 447 taverns, 551 coffeehouſes, 5975 alehouſes; 1000 hackney-coaches; 400 ditto chairs; 7000 ſtreets, lanes, courts, and alleys, and 150,000 dwelling-houſes, containing, as has

156 Number of inhabitants. been already obſerved, about 1,000,000 inhabitants; who, according to a moderate eſtimate, are ſuppoſed to conſume the following proviſions weekly:

157 Weekly conſumpt of proviſions.

	L.	s.	d.
1000 Bullocks, at 6l. a-piece -	L. 6000	0	0
6000 Sheep, at 12s. a-piece -	3600	0	0
2000 Calves, at 1l. 4s. a-piece -	2400	0	0
3000 Lambs, at 8s. a-piece, for ſix months - - - -	1200	0	0
1500 Hogs in pork and bacon, at 20s. for ſix months - -	1500	0	0
2000 Pigs, at 2s. 6d. a-piece -	250	0	0
1000 Turkeys, at 3s. 6d. a-piece for ſix months - - -	175	0	0
1000 Geeſe, at 2s. 6d. a-piece, for ſix months - - -	125	0	0
2000 Capons, at 1s. 8d. a-piece	166	13	2
500 Dozens of chickens, at 9s. per dozen - -	225	0	0
4300 Ducks at 9d. a-piece -	161	5	0
1500 Dozens of rabbits, at 7s. per dozen, for eight months -	525	0	0
2000 Dozens of pigeons, at 2s. per dozen, for eight months -	200	0	0
700 Dozens of wild fowl, of ſeveral ſorts, for ſix months - -	250	0	0
In ſalt and freſh fiſh, at 1d. a-day, for half a million of people for a week.	14,583	6	8
In bread of all ſorts, white and brown at 1d. a-day, for one million of people for a week - -	29,166	13	4
300 Tons of wine, of all ſorts, at 50l. a ton, one ſort with another, for one week - - -	15,000	0	0
In milk, butter, cheeſe, &c. at 1d. a-day, for a million of people for a week - - -	29,166	13	4
In fruit of all ſorts, at one farthing a-day, for a million of people for a week - - -	7291	13	4
In eggs of hens, ducks, geeſe, &c. at half a farthing a-day, for a million of people for a week	3645	16	4
In beer and ale, ſtrong and ſmall, at 2d. a-day, for a million of people for a week - - -	58,333	6	8
In ſugar, plums, and ſpice, and all ſorts of grocery, at a halfpenny a-day, for a million of people for a week - - -	14,583	6	8
In wheat-flour, for pies and puddings, oat-meal and rice, &c. at half a farthing a-day, for a million of people for a week - -	3645	16	8
In ſalt, oil, vinegar, capers, olives, and other ſauces, at half a farthing a-day, for a million of people for a week - - -	L. 3645	16	8
In roots and herbs of all ſorts, both for food and phyſic, at half a farthing a-day, for a million of people for a week - - -	3645	16	8
In ſea-coal, charcoal, candles, and fire wood, of all ſorts, at 1d. a-day, for a million of people for a week	29,166	13	4
In paper of all ſorts (a great quantity being uſed in printing) quills, pens, ink, and wax, at a farthing a-day, for a million of people for a week	7291	13	4
In tobacco, pipes, and ſnuff, at half a farthing a-day, for a million of people for a week - -	3645	16	8
In clothing, as linen and woollen, for men, women, and children, ſhoes, ſtockings, &c. at 3s. 6d. per week, for a million of people for a week - - -	175,000	0	0
Expences for horſe meat, in hay, oats, beans, 1000 load of hay a-week, at 40s. a load, comes to 2000l. in oats and beans the like value, 2000l. which is in all, for one week -	4000	0	0
Cyder, mum, brandy, ſtrong waters, coffee, chocolate, tea, &c. at 1d. a-day, for a million of people for one week - - -	29,166	13	4

London.

The common firing is pit coal, commonly called *ſea* 158 Firing, porter, &c.
coal, of which there are conſumed upwards of 766,880 chaldrons every year. The annual conſumption of oil in London and Weſtminſter for lamps, amounts to 400,000l. In 1787, the quantity of porter brewed in London for home conſumption and foreign exportation, amounted to 1,176,856 barrels. In 1805 it amounted to 1,200,000 barrels of 36 gallons each.

The above was the weekly conſumption of the articles ſpecified a few years ago. The following is the annual conſumption of ſome of them eſtimated ſince the year 1800. Bullocks 110,000: ſheep and lambs 776,000: calves 210,000: hogs 210,000: ſucking pigs 60,000: milk in gallons 6,980,000; for which the inhabitants pay 481,666l. and this is the produce of 8,500 cows: vegetables and fruit 3,000,000l.: ſpirituous liquors and compounds 11,146,782 gallons: wine 32,500 tons: butter 16,600,000 pounds: cheeſe 21,100,000 pounds.

This great and populous city is happily ſupplied 159 Supply of water. with abundance of freſh water from the Thames and the New River; which is not only of inconceivable ſervice to every family, but by means of fire plugs everywhere diſperſed, the keys of which are depoſited with the pariſh officers, the city is in a great meaſure ſecured from the ſpreading of fire; for theſe plugs are no ſooner opened, than there are vaſt quantities of water to ſupply the engines. This plenty of water has been attended with another advantage, it has given 160 Inſurance companies. riſe to ſeveral companies, who enſure houſes and goods from fire; an advantage that is not to be met with in any other nation on earth: the premium is ſmall; and the recovery in caſe of loſs is eaſy and cer-

tain.

London, London-derry.

tain. Every one of thefe offices keeps a fet of men in pay, who are ready at all hours to give their affiftance in cafe of fire; and who are on all occafions extremely bold, dexterous, and diligent: but though all their labours fhould prove unfuccefsful, the perfon who fuffers by this devouring element has the comfort that muft arife from a certainty of being paid the value (upon oath) of what he has enfured.

161 Places of diverfion, &c.

The places for diverfion are, Vauxhall, Ranelagh-gardens, the two play-houfes, the Pantheon, and the little theatre in the Hay Market, with Sadlers-wells, Hughes's Circus, and Aftley's Royal-Grove, &c. The fineft repofitories of rarities and natural hiftory, are Sir Hans Sloane's, in the Britifh Mufeum, already defcribed; and another collected by Sir Afhton Lever, afterwards the private property of Mr Parkinfon, and depofited in apartments for public infpection, near the fouth end of Blackfriars bridge, was fold in 1806.

The Royal Inftitution owed its origin to a number of noblemen and gentlemen, who held meetings for the avowed purpofe of ameliorating the condition of the poor. They firft projected the plan of its foundation, which was matured by the exertions and talents of the indefatigable Count Rumford. The meetings began in 1800, fhortly before which his majefty granted the proprietors a charter of incorporation by the name of the *Royal Inftitution of Great Britain*, for the purpofe of facilitating the general introduction of ufeful mechanical inventions and improvements, and for teaching, by courfes of philofophical lectures and experiments, the application of fcience to the common purpofes of life.

The government of the fociety confifts of the prefident, 15 managers, and the fecretary, chofen by and from among the proprietors. Of the 15 managers, one-third is elected annually, on the firft of May. The houfe is fituated in Albemarle-ftreet, is extremely fpacious, and well adapted to the purpofes to which it is applied.

The London Inftitution was formed in the autumn of 1805, by the indefatigable exertions of a few fpirited individuals. The houfe in the mean time is in the Old Jewry, till the managers can procure a more fuitable place. The defign of it is to promote the diffemination of fcience, literature, and the arts: its view at prefent being confined to three objects, viz. the acquifition of a a valuable and extenfive library; the diffufion of ufeful knowledge by the means of lectures and experiments; and the eftablifhment of a reading room, where the foreign and domeftic journals are provided for the ufe of the proprietors and fubfcribers. The government of the inftitution is vefted in a prefident, four vice-prefidents, twenty managers, and the fecretary. The number of proprietors is limited to 1000, each of whom paid 75 guineas for a fhare, and the life fubfcribers pay 25 guineas.

LONDONDERRY, or COLERAIN, a county of Ireland, in the province of Ulfter. It is bounded on the fouth and fouth-weft by the county of Tyronne; by Antrim on the eaft, from which it is parted by the river Bann: by Donegal on the weft; and that county and the Deucaledonian ocean on the north. Its greateft length is about 36 miles, its breadth 30, containing about 251,510 acres. The bogs and heaths of this county are manured with fea-fhells, as thofe of Donegal. Like that, too, it is pretty champaign, and not unfruitful. It is particularly noted for a very clear river called the *Bann*, abounding with falmon, a fifh faid to delight in limpid ftreams. This river, to diftinguifh it from a leffer of the fame name, is called the *Greater* or *Lower Bann*. In order to cultivate, fettle, and civilize this county, King James I. granted it, by letters-patent, to a fociety, by the name of the *Governor and Affiftants at London of the new plantation of Ulfter in the realm of Ireland*. It contains fix baronies; and, befides the two knights of the fhire, fends to parliament two members for the city of Londonderry, and two each for Colerain and Newton-Limavady or Lamnevady.

Londonderry.

LONDONDERRY, or *Derry*, the capital of the county, and the fee of a bifhop, ftands at the bottom of Lough-Foyle. This city has a very good port, to which fhips of the greateft burden have accefs, and a confiderable trade. It will be ever famous for the gallantry and perfeverance with which it defended itfelf in three memorable fieges, in defiance of the greateft hardfhips and difcouragements, namely, 1ft, In 1641, when the rebels could not reduce it either by fraud or force. 2dly, In 1649, when it was befieged by the lord Ardes, and reduced almoft to extremity by famine, till at laft relieved by troops fent from England. 3dly, When it held out againft the French and Irifh from the 7th of December 1688 to the laft day of July 1689, though it was neither well fortified nor provided with a garrifon or ftores of provifion and ammunition, and hardly any attempt made to relieve it during fo long a time. Though the city is 20 miles up the river, yet very large fhips can come up to the quay, where there are four or five fathoms of water. It is now well fortified with a ftrong wall, befides outworks; and along the banks of the river are feveral caftles and a fort. This city is of no great antiquity, having been built and planted in the reign of James I. by a colony fent by the fociety above mentioned. The trade of the town is very confiderable, having not only a large fhare in the herring fifhery, but fending fhips alfo to the Weft Indies, New England, and Newfoundland, for which they are fo advantageoufly fituated, that a veffel bound from thence to America often arrives there before a London fhip can get clear of the foundings, or arrive in the latitude of Londonderry. Though there are a great many fhallows in Lough-Foyle, which ferves it inftead of a road; yet they are eafily avoided, as there are deep channels between them. Thefe points called *Emiftone*, *Rufterhull* or *Caldy head*, which lie a little to the weft of the mouth of the harbour, are counted the moft northerly of Ireland. The inhabitants of this city are almoft all Proteftants. It gave title of *earl* and *baron* to a branch of the family of Pitt, which became extinct in 1764; but part of the title was revived in Robert Stewart, who was created Baron Londonderry in 1789. A late traveller fays, "Derry is, perhaps, the cleaneft, beft built, and moft beautifully fituated town in Ireland; and excepting Corke, as convenient as any for commerce, foreign and domeftic." The lake almoft furrounds it; and the whole ground-plot both of it and its liberties belongs to the 12 great companies of London. Great quantities of falmon, falted and barrelled, are exported from hence to America. It contains 10,000 inhabitants, and

Long. and has a wooden bridge 1068 feet long, which was erected in 1791. Long. 7° 5′ W. Lat. 55° 4′ N.

LONG, an epithet given to whatever exceeds the usual standard of length.

Long-Boat, the largest and strongest boat belonging to any ship. It is principally employed to carry great burdens, as anchors, cables, ballast, &c. See Boat.

LONG, Roger, D. D. master of Pembroke-hall in Cambridge, Lowndes's professor of astronomy in that university, rector of Cherryhinton in Huntingdonshire, and of Bradwell *juxta mare* in Essex, was author of a well known and much approved treatise of astronomy, and the inventor of a remarkably curious astronomical machine, thus described by himself. "I have, in a room lately built in Pembroke-hall, erected a sphere of 18 feet diameter, wherein above 30 persons may sit conveniently; the entrance into it is over the south pole by six steps; the frame of the sphere consists of a number of iron meridians, not complete semicircles, the northern ends of which are screwed to a large round plate of brass, with a hole in the centre of it; through this hole, from a beam in the ceiling, comes the north pole, a round iron rod, about three inches long, and supports the upper parts of the sphere to its proper elevation for the latitude of Cambridge; the lower part of the sphere, so much of it as is invisible in England, is cut off; and the lower or southern ends of the meridians, or truncated semicircles, terminate on, and are screwed down to, a strong circle of oak, of about 13 feet diameter; which, when the sphere is put into motion, runs upon large rollers of lignum vitæ, in the manner that the tops of some windmills are made to turn round. Upon the iron meridians is fixed a zodiac of tin painted blue, whereon the ecliptic and heliocentric orbits of the planets are drawn, and the constellations and stars traced: the Great and Little Bear and Draco are already painted in their places round the north pole; the rest of the constellations are proposed to follow: the whole is turned round with a small winch, with as little labour as it takes to wind up a jack, though the weight of the iron, tin, and wooden circle, is about 1000 pounds. When it is made use of, a planetarium will be placed in the middle thereof. The whole, with the floor, is well supported by a frame of large timber." Thus far Dr Long, before this curious piece of mechanism was perfected. Since the above was written, the sphere has been completely finished; all the constellations and stars of the northern hemisphere, visible at Cambridge, are painted in their proper places upon plates of iron joined together, which form one concave surface. Dr Long published a Commencement Sermon 1728; and an answer to Dr Galley's pamphlet on Greek Accents; and died December 16th 1770, at the age of 91. As the materials for this article are scanty, we shall subjoin, from the Gentleman's Magazine *, a few traits of him, as delineated in 1769 by Mr Jones. "He is now in the 88th year of his age, and for his years vegete and active. He was lately (in October) put in nomination for the office of vice-chancellor. He executed that trust once before, I think in the year 1737; a very ingenious person, and sometimes very facetious. At the public commencement in the year 1713. Dr Greene (master of Bennet college, and afterwards bishop of Ely) being then vice-chancellor, Mr Long was pitched upon for the tripos-performance; it was witty and humorous, and has passed through divers editions. Some that remembered the delivery of it, told me, that in addressing the vice-chancellor (whom the university wags usually styled *Miss Greene*), the tripos-orator, being a native of Norfolk, and assuming the Norfolk dialect, instead of saying, *Domine Vice-Cancellarie*, did very archly pronounce the words thus, *Domina Vice-Cancellaria*; which occasioned a general smile in that great auditory. His friend the late Mr Bonfoy of Ripton told me this little incident, 'That he and Dr Long walking together in Cambridge in a dusky evening, and coming to a short *post* fixed in the pavement, which Mr B. in the midst of chat and inattention, took to be a *boy* standing in his way, he said in a hurry, 'Get out of my way, boy.' '*That boy, Sir*,' said the doctor very calmly and slily, *is a* postboy, *who turns out of his way for nobody*.'—I could recollect several other ingenious repartees if there were occasion. One thing is remarkable, he never was a hale and hearty man, always of a tender and delicate constitution, yet took great care of it. His common drink water. He always dines with the fellows in the hall. Of late years he has left off eating flesh-meats; in the room thereof, puddings, vegetables, &c. sometimes a glass or two of wine."

* For 1783, p. 983.

Longevity. LONGEVITY, length of life.

From the different longevities of men in the beginning of the world, after the flood, and in these ages, Mr Derham draws an argument for the interposition of a divine Providence.

Immediately after the creation, when the world was to be peopled by one man and one woman, the ordinary age was 900 and upwards.—Immediately after the flood, when there were three persons to stock the world, their age was cut shorter, and none of those patriarchs, but Shem, arrived at 500. In the second century we find none that reached 240: in the third, none but Terah that came to 200 years; the world, at least a part of it, by that time being so well peopled, that they had built cities, and were cantoned out into distant nations. —By degrees, as the number of people increased, their *longevity* dwindled, till it came down at length to 70 or 80 years: and there it stood, and has continued to stand ever since the time of Moses.—This is found a good medium, and by means hereof the world is neither overstocked, nor kept too thin; but life and death keep a pretty equal pace.

That the common duration of man's life has been the same in all ages since the above period, is plain both from sacred and profane history. To pass by others, Plato lived to 81, and was accounted an old man: and the instances of *longevity* produced by Pliny, lib. vii. c. 48. as very extraordinary, may most of them be matched in modern histories.—In the following Tables are collected into one point of view the most memorable instances of long-lived persons of whose age we have any authentic records. The first and second are extracted from *Mr Whitehurst's Inquiry into the Origin and Strata of the Earth*, with some additions by Dr Fothergill; who inserted them, accompanied by a third, together with a number of useful observations, in the first volume of the Memoirs of the Manchester Literary Society.

Longevity.

Names of the Perfons.	Age.	Places of Abode.	Living or Dead.
Thomas Parre	152	Shropfhire	Died November 16. 1635. Phil. Tranf. N° 44.
Henry Jenkins	169	Yorkfhire	Died December 8. 1670. Phil. Tranf. N° 221.
Robert Montgomery	126	Ditto	Died in — — 1670.
James Sands	140	Staffordfhire	Do. Fuller's Worthies, p. 47.
His Wife	120	Ditto	
Countefs of Defmond	140	Ireland	Raleigh's Hift. p. 166.
———Eclefton	143	Ditto	Died — — 1691. (A)
J. Sagar	112	Lancafhire	—— — — 1668. (B)
—Laurence	140	Scotland	Living — — (C)
Simon Sack	141	Trionia	Died May 30. 1764.
Col. Thomas Winflow	146	Ireland	—— Aug. 26. 1766.
Francis Confift	150	Yorkfhire	—— Jan. — 1768.
Chrift. J. Drakenberg	146	Norway	—— June 24. 1770. (D)
Margaret Forfter	136	Cumberland	Both living 1771.
———her daughter	104	Ditto	
Francis Bons	121	France	Died Feb. 6. 1769.
John Brookey	134	Devonfhire	Living — — 1777. (E)
James Bowels	152	Killingworth	Died Aug. 15. 1656. (F)
John Tice	125	Worcefterfhire	—— March 1774. (G)
John Mount	136	Scotland	—— Feb. 27. 1766. (H)
A. Goldfmith	140	France	—— June — 1776. (I)
Mary Yates	128	Shropfhire	—— — — 1776. (K)
John Bales	126	Northampton	—— April 5. 1776. (L)
William Ellis	130	Liverpool	—— Aug. 16. 1780. (M)
Louifa Truxo, a Negrefs	175	Tucomea, S. America	Living Oct. 5. 1780 (N)
Margaret Patten	138	Lockneugh near Paifley	Lynche's Guide to Health.
Janet Taylor	108	Fintray, Scotland	Died Oct. 10. 1780.
Richard Lloyd	133	Montgomery	Lynche's Guide to Health.
Sufannah Hilliar	100	Piddington, Northampfh	Died. Feb. 19. 1781. (O)
Ann Cockbolt	105	Stoke-Bruerne, *Ib.*	—— April 5. 1775. (P)
James Hayley	112	Middlewich, Chefhire	—— March 17. 1781. (Q)

William Walker, aged 112, not mentioned above, who was a foldier at the battle of Edgehill.

If we look back to an early period of the Chriftian era, we fhall find that Italy has been, at leaft about that time, peculiarly propitious to longevity. Lord Bacon obferves that the year of our Lord 76, in the reign of Vefpafian, was memorable; for in that year was a taxing which afforded the moft authentic method of knowing the ages of men. From it, there were found in that part of Italy lying between the Apennine mountains and the river Po, 124 perfons who either equalled or exceeded 100 years of age, namely—

	54 perfons of	-	100 years each.
	57	-	110
	2	-	125
	4 perfons of	-	130 years.
	4	-	136
	3	-	140
In Parma	3	-	120
	2	-	130
In Bruffels	1	-	125
In Placentia	1	-	131
In Faventia	1	-	132
	6	-	110
	4	-	120
In Rimino	1	-	150 years, viz.

Marcus Aponius, Mr

(A) Fuller's Worthies, p. 140.
(B) Phil. Tranf. abridged by Lowthorp, vol iii. p. 30, 6.
(C) Derham's Phyfico-Theology, p. 173.
(D) Annual Regifter.
(E) Daily Advertifer, Nov. 18. 1777.
(F) Warwickfhire.
(G) Daily Advertifer, March 1774.
(H) Morning Poft, Feb. 29. 1776.
(I) Daily Advertifer, June 24. 1776.
(K) Daily Advertifer, Aug. 22. 1776.
(L) See Infcription in the portico of All-Saints church.
(M) London Even. Poft, Aug. 22. 1780.
(N) London Chronicle, Oct. 5. 1780.
(O) Northamp. Mercury, Feb. 19. 1781.
(P) Well known to perfons of credit in Northampton.
(Q) Gen. Evening Poft, March 24. 1781.

Longevity.

Mr Carew, in his Survey of Cornwall, assures us, that it is no unusual thing with the inhabitants of that county to reach 90 years of age and upwards, and even to retain their strength of body and perfect use of their senses. Besides Brown, the Cornish beggar, who lived to 120, and one Polezew to 130 years of age, he remembered the decease of four persons in his own parish, the sum of whose years, taken collectively, amounted to 340. Now, although longevity evidently prevails more in certain districts than in others, yet it is by no means confined to any particular nation or climate; nor are there wanting instances of it in almost every quarter of the globe, as appears from the preceding as well as the subsequent Table; which might have been considerably enlarged, had it appeared necessary; but we have only added, in the last, three recent instances that are peculiarly remarkable.

Names of the Persons.	Age.	Places of Abode.	Where recorded.
Hippocrates, Physician	104	Island of Cos	Lynche on Health, chap. 3.
Democritus, Philosopher	109	Abdera	Bacon's History, 1095.
Galen, Physician	140	Pergamus	Voss. Inst. lib. iii.
Albuna, Marc	150	Ethiopia	Hakewell's Ap. lib. i.
Dumitur Raduly	140	Haromszeck, Transylvania	Died Jan. 18. 1782. General Gazetteer, April 18.
Titus Fullonius	150	Bononia	Fulgosus, lib. viii.
Abraham Paiba	142	Charlestown, South-Car.	General Gazetteer.
L. Tertulla	137	Ariminum	Fulgosus, lib. viii.
Lewis Cornaro	100	Venice	Bacon's Hist. of Life, p. 134.
Robert Blackeney, Esq.	114	Armagh, Ireland	General Gazetteer.
Margaret Scott	125	Dalkeith, Scotland	Inscription on her tomb there.
W. Gulstone	140	Ireland	Fuller's Worthies.
J. Bright	105	Ludlow	Lynche on Health.
William Postell	120	France	Bacon's History, p. 134.
Jane Reeves	103	Essex	St James's Chron. June 14. 1781.
W. Paulet, Marquis of Winchester	106	Hampshire	Baker's Chron. p. 502.
John Wilson	116	Suffolk	Gen. Gaz. Oct. 29. 1782.
Patrick Wian	115	Lesbury, Northumberd.	Plemp. Fundam. Med. § 4. c. 8.
M. Laurence	140	Orcades	Buchanan's Hist. of Scotland.
Evan Williams	145	Caermarthen workhouse, still alive	General Gazetteer, Oct. 12th 1782.
John Jacobs (R)	121	Mount Jura	All the public prints, Jan. 1790.
Matthew Tait (S)	123	Auchinleck, Ayrshire	Died Feb. 19. 1792. Edin. Even. Cour. Mar. 8. 1792.
Donald Macleod (T)	104	Isle of Sky. Alive Jan. 1792.	All the public prints at the end of 1790; and *Memoirs*, &c.

(R) This man, in 1789, at the age of 120, quitted his native hills, and from the summit of Mount Jura undertook a journey to Versailles, to behold and return thanks to the national assembly for the vote which had freed him and his poor countrymen from the feudal yoke. In the early part of his life, he was a servant in the family of the prince de Beaufremont. His memory continued good to the last day of his life; and the principal inconveniences which he felt from his great age were, that his sight was weakened, and the natural heat of his body was so diminished, that he shivered with cold in the middle of the dog-days if he was not fitting by a good fire. This old man was received in the body of the house by the national assembly, indulged with a chair, and directed to keep on his hat lest he should catch cold if he was to sit uncovered. A collection was made for him by the members, which exceeded 500l. sterling; but he lived not to return to Mount Jura. He was buried on Saturday the 31st of January 1790, with great funeral pomp, in the parish-church of St Eustace at Paris.

(S) He served as a private at the taking of Gibraltar in 1704.

(T) *Memoirs of the Life and gallant Exploits of the Old Highlander Serjeant Donald Macleod*, &c. published 1791, in the 103d year of his age.—This old gentleman, for it appears that he really is a gentleman both by birth and by behaviour, was born in the year of the Revolution, in the parish of Bracadill, in the isle of Sky and county of Invernefs, North Britain. He is a cadet of the family of Ulinish in Sky; and descended, through his mother, from Macdonald of Slate, the ancestor of the present Lord Macdonald. The earlier part of his life coincided with the famine of seven years in Scotland; which was so great as to suggest, even to the patriotic Mr Fletcher, the idea of the people selling themselves as slaves for immediate subsistence. He was

Longevity.

A certain author mentions a list collected by himself of 107 persons, who all died at the age of 120 and upwards. Two of them attained the age of 150, three of 152, one of 154, one of 169, and another 175. In 1763 there were found in Sweden 988 females above 90 years of age. We have seen a list of 104 persons, none of whom died under 120 years of age, and one of them, it is said, lived to the prodigious age of 180. Forty-one of them belonged to England, 16 to Scotland, and 24 to Ireland.

The antediluvians are purposely omitted, as bearing too little reference to the present race of mortals, to afford any satisfactory conclusions; and as they have been already taken notice of in a separate article; (see ANTEDILUVIANS). As the improbable stories of some persons who have almost rivalled them in modern times, border too much upon the marvellous to find a place in these tables, the present examples are abundantly sufficient to prove, that longevity does not depend, so much as has been supposed, on any particular climate, situation, or occupation in life: for we see, that it often prevails in places where all these are extremely dissimilar; and it would, moreover, be very difficult, in the histories of the several persons above mentioned, to find any circumstance common to them all, except, perhaps, that of being born of healthy parents, and of being inured to daily labour, temperance, and simplicity of diet. Among the inferior ranks of mankind, therefore, rather than among the sons of ease and luxury, shall we find the most numerous instances of longevity; even frequently, when other external circumstances seem extremely unfavourable; as in the case of the poor sexton at Peterborough, who, notwithstanding his unpromising occupation among dead bodies, lived long enough to bury two crowned heads, and to survive two complete generations. The livelihood of Henry Jenkins and old Parre is said to have consisted chiefly of the coarsest fare, as they depended on precarious alms. To which may be added the remarkable instance of Agnes Milbourne, who, after bringing forth a numerous offspring, and being obliged, through extreme indigence, to pass the latter part of her life in St Luke's workhouse, yet reached her 106th year in that sordid and unfriendly situation. The plain diet and invigorating employments of a country life are acknowledged on all hands to be highly conducive to health and longevity, while the luxury and refinements of large cities are allowed to be equally destructive to the human species; and this consideration alone, perhaps, more than counterbalances all the boasted privileges of superior elegance and civilization resulting from a city life.

From country villages, and not from crowded cities, have the preceding instances of longevity been chiefly supplied. Accordingly it appears, from the London bills of mortality, during a period of 30 years, viz. from the year 1728 to 1758, the sum of the deaths amounted to 750,322, and that, in all this prodigious number, only 242 persons survived the 100th year of their age! This overgrown metropolis is computed by Dr Price to contain a ninth part of the inhabitants of England, and to consume annually 7000 persons, who remove into it from the country every year, without increasing it. He moreover observes, that the number of inhabitants in England and Wales has diminished about one-fourth part since the Revolution; and so rapidly of late, that in 11 years, near 200,000 of our common people have been lost. If the calculation be just, however alarming it may appear in a national view, there is this consolation, when considered in a philosophical light, that without partial evil, there can be no general good; and

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was bred in the midst of want and hardships, cold, hunger, and for the years of his apprenticeship with a mason and stone-cutter in Inverness, in incessant fatigue. He inlisted, when a boy, in the Scottish service, in the town of Perth in the last year of the reign of King William. The regiment into which he inlisted was the Scots Royals, commanded by the earl of Orkney. That old military corps, at that time, used bows and arrows as well as swords, and wore steel caps. He served in Germany and Flanders under the duke of Marlborough; under the duke of Argyle, in the rebellion 1715; in the Highland Watch, or companies raised for enforcing the laws in the Highlands; in the same companies when, under the name of the 42d regiment, they were sent abroad to Flanders, to join the army under the duke of Cumberland; in the same regiment in Ireland, and on the breaking out of the French war, 1757, in America. From the 42d he was draughted to act as a drill serjeant in the 78th regiment, in which he served at the reduction of Louisburg and Quebec: After this he became an out-pensioner of Chelsea Hospital. But such was the spirit of this brave and hardy veteran, that he served in 1761 as a volunteer in Germany under the marquis of Granby; and offered his services in the American war to Sir Henry Clinton; who, though he declined to employ the old man in the fatigues and dangers of war, treated him with great kindness, allowed him a liberal weekly pension out of his own pocket, and sent him home in a ship charged with despatches to government.—The serjeant, "as his memory, according to the observation of his biographer, is impaired, does not pretend to make an exact enumeration of all his offspring: but he knows of 16 sons now living, 14 of whom are in the army and navy, besides daughters; the eldest of whom by his present wife is a mantuamaker at Newcastle.—His eldest son is now 83 years old, and the youngest only nine. Nor, in all probability, would this lad close the rear of his immediate progeny, if his present wife, the boy's mother, had not attained to the 49th year of her age."—In his prime, he did not exceed five feet and seven inches. He is now inclined through age to five feet five inches. He has an interesting physiognomy, expressive of sincerity, sensibility, and manly courage. His biographer very properly submits it to the consideration of the Polygraphic Society, whether they might not do a thing worthy of themselves and their ingenious art, if they should multiply likenesses of this living antiquity, and circulate them at an easy rate throughout Britain and Europe. They would thus gratify a very general curiosity; a curiosity not confined to the present age.

Longevity.

and that what a nation loſes in the ſcale of population at one period, it gains at another; and thus probably, the average number of inhabitants on the ſurface of the globe continues at all times nearly the ſame. By this medium, the world is neither overſtocked with inhabitants nor kept too thin, but life and death keep a tolerably equal pace. The inhabitants of this iſland, comparatively ſpeaking, are but as the duſt of the balance; yet inſtead, of being diminiſhed, we are aſſured by other writers, that within theſe 30 years they are greatly increaſed.

The deſire of ſelf-preſervation, and of protracting the ſhort ſpan of life, is ſo intimately interwoven with our conſtitution, that it is juſtly eſteemed one of the firſt principles of our nature, and, in ſpite even of pain and miſery, ſeldom quits us to the laſt moments of our exiſtence. It ſeems, therefore, to be no leſs our duty than our intereſt, to examine minutely into the various means that have been conſidered as conducive to health and long life: and, if poſſible, to diſtinguiſh ſuch circumſtances as are eſſential to that great end from thoſe which are merely accidental. But here it is much to be regretted, that an accurate hiſtory of the lives of all the remarkable perſons in the above table, ſo far as relates to the diet, regimen, and the uſe of the non-naturals, has not been faithfully handed down to us; without which it is impoſſible to draw the neceſſary inferences. Is it not then a matter of aſtoniſhment, that hiſtorians and philoſophers have hitherto paid ſo little attention to longevity? If the preſent imperfect liſt ſhould excite others, of more leiſure and better abilities, to undertake a full inveſtigation of ſo intereſting a ſubject, the inquiry might prove not only curious but highly uſeful to mankind. In order to furniſh materials for a future hiſtory of longevity, the bills of mortality throughout the kingdom ought firſt to be reviſed, and put on a better footing, agreeable to the ſcheme of which Mancheſter and Cheſter have already given a ſpecimen highly worthy of imitation. The plan, however, might be further improved with very little trouble, by adding a particular account of the diet and regimen of every perſon who dies at 80 years of age or upwards; and mentioning whether his parents were healthy, long-lived people, &c. An accurate regiſter, thus eſtabliſhed throughout the Britiſh dominions, whould be productive of many important advantages to ſociety, not only in a medical and philoſophical, but alſo in a political and moral view.

All the circumſtances that are moſt eſſentially neceſſary to life, may be compriſed under the ſix following heads: 1. Air and climate; 2. Meat and drink; 3. Motion and reſt; 4. The ſecretions and excretions; 5. Sleep and watching; 6. Affections of the mind.

Theſe, though all perfectly natural to the conſtitution, have by writers been ſtyled the non-naturals, by a ſtrange perverſion of language; and have been all copiouſly handled under that improper term. However, it may not be amiſs to offer a few ſhort obſervations on each, as they are ſo immediately connected with the preſent ſubject.

1. *Air*, &c. It has long been known that freſh air is more immediately neceſſary to life than food; for a man may live two or three days without the latter, but not many minutes without the former. The vivifying principle contained in the atmoſphere, ſo eſſential to the ſupport of flame, as well as animal life, concerning which authors have propoſed ſo many conjectures, appears now to be nothing elſe but that pure dephlogiſticated fluid lately diſcovered by that ingenious philoſopher Dr Prieſtley. The common atmoſphere may well be ſuppoſed to be more or leſs healthy in proportion as it abounds with this animating principle. As this exhales in copious ſteams from the green leaves of all kinds of vegetables, even from thoſe of the moſt poiſonous kinds, may we not, in ſome meaſure account why inſtances of longevity are ſo much more frequent in the country than in large cities; where the air, inſtead of partaking ſo largely of this ſalutary impregnation, is daily contaminated with noxious animal effluvia and phlogiſton?

With reſpect to climate, various obſervations conſpire to prove, that thoſe regions which lie within the temperate zones are beſt calculated to promote long life. Hence, perhaps, may be explained, why Italy has produced ſo many long livers, and why iſlands in general are more ſalutary than continents; of which Bermudas and ſome others afford examples. And it is a pleaſing circumſtance that our own iſland appears from the above table (notwithſtanding the ſudden viciſſitudes to which it is liable) to contain far more inſtances of longevity than could well be imagined. The ingenious Mr Whitehurſt aſſures us, from certain facts, that Engliſhmen are in general longer lived than North Americans; and that a Britiſh conſtitution will laſt longer, even in that climate, than a native one. But it muſt be allowed in general, that the human conſtitution is adapted to the peculiar ſtate and temperature of each reſpective climate, ſo that no part of the habitable globe can be pronounced too hot or too cold for its inhabitants. Yet, in order to promote a friendly intercourſe between the moſt remote regions, the Author of nature has wiſely enabled the inhabitants to endure great and ſurpriſing chnges of temperature with impunity.

2. *Foods and drink*. Though foods and drink of the moſt ſimple kinds are allowed to be the beſt calculated for ſupporting the body in health, yet it can hardly be doubted but variety may be ſafely indulged occaſionally, provided men would reſtrain their appetites within the bounds of temperance: for bountiful Nature cannot be ſuppoſed to have poured forth ſuch a rich profuſion of proviſions, merely to tantalize the human ſpecies, without attributing to her the part of a cruel ſtepdame, inſtead of that of the kind and indulgent parent. Beſides, we find, that by the wonderful powers of the digeſtive organs, a variety of animal and vegetable ſubſtances, of very diſcordant principles, are happily aſſimilated into one bland homogeneous chyle; therefore it ſeems natural to diſtruſt thoſe cynical writers, who would rigidly confine mankind to one ſimple diſh, and their drink to the mere water of the brook. Nature, it is true, has pointed out that mild inſipid fluid as the univerſal diluent, and therefore moſt admirably adapted for our daily beverage. But experience has equally proved, that vinous and ſpirituous liquors, on certain occaſions, are no leſs ſalutary and beneficial, whether it be to ſupport ſtrength againſt ſickneſs or bodily fatigue, or to exhilerate the mind under the preſſure of heavy misfortunes. But, alas! what

Longitude.

what Nature meant for innocent and uſeful cordials, to be uſed only occaſionally, and according to the direction of reaſon, cuſtom and caprice have by degrees rendered habitual to the human frame, and liable to the moſt enormous and deſtructive abuſes. Hence it may be juſtly doubted, whether gluttony and intemperance have not depopulated the world more than even the ſword, peſtilence, and famine. True, therefore, is the old maxim, "*Modus utendi ex veneno facit medicamentum, ex medicamento venenum.*

3. and 4. *Motion and reſt, ſleep and watching.* It is allowed on all hands, that alternate motion and reſt, and ſleep and watching, are neceſſary conditions to health and longevity; and that they ought to be adapted to age, temperament, conſtitution, temperature of the climate, &c.; but the errors which mankind daily commit in theſe reſpects become a fruitful ſource of diſeaſes. While ſome are bloated and relaxed with eaſe and indolence, others are emaciated, and become rigid through hard labour, watching, and fatigue.

5. *Secretions and excretions.* Where the animal functions are duly performed, the ſecretions go on regularly; and the different evacuations ſo exactly correſpond to the quantity of aliment taken in, in a given time, that the body is found to return daily to nearly the ſame weight. If any particular evacuation happen to be preternaturally diminiſhed, ſome other evacuation is proportionally augmented, and the equilibrium is commonly preſerved; but continued irregularities, in theſe important functions, cannot but terminate in diſeaſe.

6. *Affections of the mind.* The due regulation of the paſſions, perhaps, contributes more to health and longevity than that of any other of the non-naturals. The animating paſſions, ſuch as joy, hope, love, &c. when kept within proper bounds, gently excite the nervous influence, promote an equable circulation, and are highly conducive to health; while the depreſſing affections, ſuch as fear, grief, and deſpair, produce the contrary effect, and lay the foundation of the moſt formidable diſeaſes.

From the light which hiſtory affords us, as well as from ſome inſtances in the above table, there is great reaſon to believe, that longevity is in a great meaſure hereditary; and that healthy long-lived parents would commonly tranſmit the ſame to their children, were it not for the frequent errors in the non-naturals, which ſo evidently tend to the abbreviation of human life.

Where is it, but from theſe cauſes, and the unnatural modes of living, that, of all the children which are born in the capital cities of Europe, nearly one half die in early infancy? To what elſe can we attribute this extraordinary mortality? Such an amazing proportion of premature deaths is a circumſtance unheard of among ſavage nations, or among the young of other animals! In the earlieſt ages, we are informed, that human life was protracted to a very extraordinary length; yet how few perſons, in theſe latter times, arrive at that period which nature ſeems to have deſigned! Man is by nature a field animal, and ſeems deſtined to riſe with the ſun, and to ſpend a large portion of his time in the open air, to inure his body to robuſt exerciſes and the inclemency of the ſeaſons, and to make a plain homely repaſt only when hunger dictates. But art has ſtudiouſly defeated the kind intentions of nature; and by enſlaving him to all the blandiſhments of ſenſe, has left him, alas! an eaſy victim to folly and caprice. To enumerate the various abuſes which take place from the earlieſt infancy, and which are continued through the ſucceeding ſtages of modiſh life, would carry us far beyond our preſent intention. Suffice it to obſerve, that they prevail more particularly among people who are the moſt highly poliſhed and refined. To compare their artificial mode of life with that of nature, or even with the long-livers in the liſt, would probably afford a very ſtriking contraſt; and at the ſame time ſupply an additional reaſon why, in the very large cities, inſtances of longevity are ſo very rare.

Longford, Long-Iſland.

LONGFORD, a county of Ireland, in the province of Leinſter, bounded by the counties of Leitrim and Cavan on the north, Meath on the eaſt and ſouth, and Roſcommon on the weſt. It contains 143,700 Iriſh plantation acres, 24 pariſhes, 6 baronies, and 4 boroughs; and returns 10 members to parliament. It is ſmall, and much encumbered with bog, intermixed with a tolerable good ſoil; and is about 25 miles long and 15 broad.

LONGFORD, a town of Ireland, ſituated on the river Cromlin, in the county of Longford and province of Leinſter, 64 miles from Dublin; which river falls a few miles below this place into the Shannon. It is a borough, poſt, market, and fair town; and returns two members to parliament; patron, Lord Longford. It gave title of *earl* to the family of Aungier; of *viſcount*, to the family of Micklethwaite; and now gives that of *baron* to the family of Packenham. Within a mile and a half of the town is a charter-ſchool for above 40 children. This place has a barrack for a troop of horſe. It is large and well built; and in a very early age an abbey was founded here, of which St Idus, one of St Patrick's diſciples, was abbot. In the year 1400, a fine monaſtery was founded to the honour of the Virgin Mary, for Dominican friars, by O'Ferral prince of Annaly. This monaſtery being deſtroyed by fire, Pope Martin V. by a bull in the year 1429, granted an indulgence to all who ſhould contribute to the rebuilding of it. In 1433, Pope Eugene IV. granted a bull to the ſame purpoſe; and in 1438 he granted another to the like effect. The church of this friary, now the pariſh church, is in the dioceſe of Ardagh. The fairs are four in the year.

LONG-ISLAND, is an iſland of North America, belonging to the ſtate of New-York, which is ſeparated from the continent by a narrow channel. It extends from the city of New-York eaſt 140 miles, terminating with Montauk point; and is not more than 10 miles in breadth on a medium. It is divided into three counties, King's, Queen's, and Suffolk. The ſouth ſide of the iſland is flat land, of a light ſandy ſoil, bordered on the ſea-coaſt with large tracts of ſalt meadow, extending from the weſt point of the iſland to Southampton. This ſoil, however, is well calculated for raiſing grain, eſpecially Indian corn. The north ſide of the iſland is hilly, and of a ſtrong ſoil, adapted to the culture of grain, hay, and fruit. A ridge of hills extends from Jamaica to South-hold. Large herds of cattle feed upon Hampſtead plain and on the ſalt marſhes upon the ſouth ſide of the iſland. Hampſtead plain in Queen's county is a curioſity. It is is 16 miles in length, east and west, and 7 or 8 miles wide. The soil is black and to appearance rich, and yet it was never known to have any natural growth, but a kind of wild grass and a few shrubs. It is frequented by vast numbers of plover. Rye grows tolerably well on some parts of the plain. The most of it lies common for cattle, horses, and sheep. As there is nothing to impede the prospect in the whole length of this plain, it has a curious but tiresome effect upon the eye, not unlike that of the ocean. The island contains 30,863 inhabitants.

LONGIMETRY, the art of measuring lengths, both accessible and inaccessible. See GEOMETRY and TRIGONOMETRY.

LONGING, is a preternatural appetite in pregnant women, and in some sick persons when about to recover. It is called *pica*, from the bird of that name, which is said to be subject to the same disorder. The disorder consists of both a desire of unusual things to eat and drink, and in being soon tired of one and wanting another. It is called *malacia*, from μαλακος, "weakness." In pregnant women it is somewhat relieved by bleeding, and in about the fourth month of their pregnancy it leaves them. Chlorotic girls, and men who labour under suppressed hemorrhoids, are very subject to this complaint, and are relieved by promoting the respective evacuations. In general, whether this disorder is observed in pregnant women, in persons recovering from an acute fever, or those who labour under obstructions of the natural evacuations, this craving of the appetite should be indulged.

LONGINICO, a town of Turkey in Europe, in the Morea, anciently called *Olympia*, famous for being the place where the Olympic games were celebrated, and for the temple of Jupiter Olympus, about a mile distant. It is now but a small place, seated on the river Alpheus, 10 miles from its mouth, and 50 south of Lepanto. E. Long. 22. 0. N. Lat. 37. 30.

LONGINUS, DIONYSIUS, a celebrated Greek critic of the third century, was probably an Athenian. His father's name is unknown, but by his mother he was allied to the celebrated Plutarch. His youth was spent in travelling with his parents, which gave him an opportunity to increase his knowledge, and improve his mind. After his travels, he fixed his residence at Athens, and with the greatest assiduity applied to study. Here he published his Treatise on the Sublime; which raised his reputation to such a height, and gave the Athenians such an opinion of his judgement and taste, that they made him sovereign judge of all authors, and every thing was received and rejected by the public according to his decisions. He seems to have staid at Athens a long time; here he taught the academic philosophy, and among others had the famous Porphyry for his pupil. But it was at length his fortune to be drawn from Athens, and to mix in more active scenes; to train up young princes to virtue and glory; to guide the busy passions of the great to noble objects; to struggle for, and at last to die in, the cause of liberty. Zenobia, queen of the East, prevailed on him to undertake the education of her sons: and he soon gained an uncommon share in her esteem: she spent the vacant hours of her life in his conversation, and modelled her sentiments and conduct by his instructions. That princess was at war with Aurelian; and being defeated by him near Antioch, was compelled to shut herself up in Palmyra, her capital city. The emperor wrote her a letter, in which he ordered her to surrender; to which she returned an answer, drawn up by Longinus, which filled him with resentment. The emperor laid siege to the city; and the Palmyrians were at length obliged to open their gates and receive the conqueror. The queen and Longinus endeavoured to fly into Persia; but were unhappily overtaken and made prisoners when they were on the point of crossing the Euphrates. The queen, intimidated, weakly laid the blame of vindicating the liberty of her country on its true author; and the brave Longinus, to the disgrace of the conqueror, was carried way to immediate execution. The writings of Longinus were numerous, some on philosophical, but the greater part on critical subjects. Dr Pearce has collected the titles of 25 treatises, none of which, excepting that on the Sublime, have escaped the depredations of time and barbarians. On this imperfect piece the great fame of Longinus is raised, who, as Pope expresses it—"is himself the great sublime he draws." The best edition of his works is that by Tollius, printed at Utrecht in 1694, *cum notis variorum*. It has been translated into English by Mr Smith.

LONGISSIMUS DORSI. See ANATOMY, *Table of the Muscles*.

LONGITUDE, in *Geography* and *Navigation*, is the distance of any place from another eastward or westward, counted in degrees upon the equator: but when the distance is reckoned by leagues or miles and not in degrees, or in degrees on the meridian, and not of the parallel of latitude, in which case it includes both latitude and longitude, it is called *departure*.

To find the longitude at sea, is a problem to which the attention of navigators and mathematicians has been drawn ever since navigation began to be improved.—The importance of this problem soon became so well known, that, in 1598, Philip III. of Spain offered a reward of 1000 crowns for the solution; and his example was soon followed by the States General, who offered 10,000 florins. In 1714 an act was passed in the British parliament, empowering certain commissioners to make out a bill for a sum not exceeding 2000l. for defraying the necessary expences of experiments for ascertaining this point; and likewise granting a reward to the person who made any progress in the solution, proportionable to the degree of accuracy with which the solution was performed: 10,000l. was granted if the longitude should be determined to one degree of a great circle, or 60 geographical miles; 15,000l. if to two thirds of that distance; and 20,000l. if to half the distance.

In consequence of these proffered rewards, innumerable attempts were made to discover this important secret. The first was that of John Morin professor of mathematics at Paris, who proposed it to Cardinal Richelieu; and though it was judged insufficient on account of the imperfection of the lunar tables, a pension of 2000 livres per annum was procured for him in 1645 by Cardinal Mazarine. Gemma Frisius had indeed, in 1530, projected a method of finding the longitude by means of watches, which at that time were newly invented: but the structure of these machines was then by far too imperfect to admit of any attempt; nor even

Longitude. in 1631, when Metius made an attempt to this purpofe, were they advanced in any confiderable degree. About the year 1664, Dr Hooke and Mr Huygens made a very great improvement in watchmaking, by the application of the pendulum fpring. Dr Hooke having quarrelled with the miniftry, no experiment was made with any of his machines; but many were made with thofe of Mr Huygens. One experiment particularly, made by Major Holmes, in a voyage from the coaft of Guinea in 1665, anfwered fo well, that Mr Huygens was encouraged to improve the ftructure of his watches: but it was found that the variations of heat and cold produced fuch alterations in the rate of going of the watch, that unlefs this could be remedied, the watches could be of little ufe in determining the longitude.

In 1714 Henry Sully, an Englifhman, printed a fmall tract at Vienna upon the fubject of watchmaking. Having afterwards removed to Paris, he applied himfelf to the improvement of time-keepers for the difcovery of the longitude. He taught the famous Julian de Roy: and this gentleman, with his fon, and M. Berthoud, are the only perfons who fince the days of Sully, have turned their thoughts this way. But though experiments have been made at fea with fome of their watches, it does not appear that they have been able to accomplifh any thing of importance with regard to the main point. The firft who fucceeded in any confiderable degree was Mr John Harrifon; who, in 1726, produced a watch which went fo exactly, that for ten years together it did not err above one fecond in a month. In 1736 it was tried in a voyage to Lifbon and back again, on board one of his majefty's fhips; during which it corrected an error of a degree and a half in the computation of the fhip's reckoning. In confequence of this he received public encouragement to go on: and by the year 1761 had finifhed three time-keepers, each of them more accurate than the former. The laft turned out fo much to his fatisfaction, that he now applied to the commiffioners of longitude for leave to make an experiment with his watch in a voyage to the Weft Indies. Permiffion being granted, his fon Mr William Harrifon fet out in his majefty's fhip the Deptford for Jamaica in the month of November 1761. This trial was attended with all imaginable fuccefs. The longitude of the ifland, as determined by the time-keeper, differed from that found by aftronomical obfervations only one minute and a quarter of the equator; the longitudes of places feen by the way being alfo determined with great exactnefs. On the fhip's return to England, it was found to have erred no more during the whole voyage than 1′ 54½″ in time, which is little more than 28 miles in diftance; which being within the limits prefcribed by the act, the inventor claimed the whole 20,000l. offered by government. Objections to this, however, were foon ftarted. Doubts were pretended about the real longitude of Jamaica, as well as the manner in which the time had been found both there and at Portfmouth. It was alleged alfo, that although the time-keeper happened to be right at Jamaica, and after its return to England, this was by no means a proof that it had always been fo in the intermediate times; in confequence of which allegations, another trial was appointed in a voyage to Barbadoes. Precautions were now taken to obviate as many of thefe objections as poffible. The commiffioners fent out proper perfons to make aftronomical obfervations at that ifland: which, when compared with others in England, would afcertain beyond a doubt its true fituation. In 1764 then, Mr Harrifon junior fet fail for Barbadoes; and the refult of the experiment was, that the difference of longitude betwixt Portfmouth and Barbadoes was fhown by the time-keeper to be 3h. 55′ 3″; and by aftronomical obfervations to be 3h. 54′ 20″; the error being now only 43″ of time, or 10′ 45″ of longitude. In confequence of this and the former trials, Mr Harrifon received one half of the reward promifed, upon making a difcovery of the principles upon which his time-keepers were conftructed. He was likewife promifed the other half of the reward as foon as time-keepers fhould be conftructed by other artifts which fhould anfwer the purpofe as well as thofe of Mr Harrifon himfelf. At this time he delivered up all his time-keepers, the laft of which was fent to Greenwich to be tried by Mr Nevil Mafkelyne, the aftronomer-royal. On trial, however, it was found to go with much lefs regularity than had been expected; but Mr Harrifon attributed this to his having made fome experiments with it which he had not time to finifh when he was ordered to deliver up the watch. Soon after this, an agreement was made by the commiffioners with Mr Kendall to conftruct a watch upon Mr Harrifon's principles; and this upon trial was found to anfwer the purpofe even better than any that Harrifon himfelf had conftructed. This watch was fent out with Captain Cook in 1772; and during all the time of his voyage round the world in 1772, 1773, 1774, and 1775, never erred quite 14½ feconds per day: in confequence of which, the houfe of commons, in 1774, ordered the other 10,000l. to be paid to Mr Harrifon. Still greater accuracy, however, has been attained. A watch was lately conftructed by Mr Arnold, which, during a trial of 13 months, from February 1779 to February 1780, varied no more than 6.69″ during any two days; and the greateft difference between its rates of going on any day and the next to it was 4.11″. The greateft error it would have committed therefore in the longitude during any fingle day would have been very little more than one minute of longitude; and thus might the longitude be determined with as great exactnefs as the latitude generally can.—This watch, however, has not yet been tried at fea.

Thus the method of conftructing time-keepers for difcovering the longitude feems to be brought to as great a degree of perfection as can well be expected. Still, however, as thefe watches are fubject to accidents, and may thus alter the rate of their going without any poffibility of a difcovery, it is neceffary that fome other method fhould be fallen upon, in order to correct from time to time thofe errors which may arife either from the natural going of the watch, or from any accident which may happen to it. Methods of this kind are all founded upon celeftial obfervations of fome kind or other; and for thefe methods, or even for an improvement in time-keepers, rewards are ftill held out by government. After the difcoveries made by Mr Harrifon, the act concerning the longitude was repealed, excepting fo much of it as related to the conftructing, printing, publifhing, &c. of nautical almanacks and other ufeful tables. It was enacted alfo, that

Longitude.

that any perſon who ſhall diſcover a method for finding the longitude by means of a time-keeper, the principles of which have not hitherto been made public, ſhall be entitled to a reward of 5000l. if, after certain trials made by the commiſſioners, the ſaid method ſhall enable a ſhip to keep her longitude, during a voyage of ſix months, within 60 geographical miles, or a degree of a great circle. If the ſhip keeps her longitude within 40 geographical miles for that time, the inventor is entitled to a reward of 7500l. and to 10,000l. if the longitude is kept within half a degree. If the method is by improved aſtronomical tables, the author is entitled to 5000l. when they ſhow the diſtance of the moon from the ſun and ſtars within 15 ſeconds of a degree, anſwering to about 7 minutes of longitude, after allowing half a degree for errors of obſervation and under certain reſtrictions, and after compariſon with aſtronomical obſervations for a period of 18½ years, during which the lunar irregularities are ſuppoſed to be completed. The ſame rewards are offered to the perſon who ſhall with the like accuracy diſcover any other method of finding the longitude.

Theſe methods require celeſtial obſervations; and any of the phenomena, ſuch as the different apparent places of ſtars with regard to the moon, the beginning and ending of eclipſes, &c. will anſwer the purpoſe: only it is abſolutely neceſſary that ſome variation ſhould be perceptible in the phenomenon in the ſpace of two minutes; for even this ſhort ſpace of time will produce an error of 30 miles in longitude. The moſt proper phenomena therefore for determining the longitude in this manner are the eclipſes of Jupiter's ſatellites. Tables of their motions have been conſtructed, and carefully corrected from time to time, as the mutual attractions of theſe bodies are found greatly to diſturb the regularity of their motions. The difficulty here, however, is to obſerve theſe eclipſes at ſea; and this difficulty has been found ſo great, that no perſon ſeems able to ſurmount it. The difficulty ariſes from the violent agitation of a ſhip in the ocean, for which no adequate remedy has ever yet been found, nor probably will ever be found. Mr Chriſtopher Irwin indeed invented a machine which he called a *marine chair*, with a view to prevent the effects of this agitation; but on trying it in a voyage to Barbadoes, it was found to be totally uſeleſs.

A whimſical method of finding the longitude was propoſed by Meſſrs Whiſton and Ditton from the report and flaſh of great guns. The motion of ſound is known to be nearly equable, from whatever body it proceeds or whatever be the medium. Suppoſing therefore a mortar to be fired at any place the longitude of which is known, the difference between the moment that the flaſh is ſeen and the report heard will give the diſtances between the two places; whence, if we know the latitudes of theſe places, their longitudes muſt alſo be known. If the exact time of the exploſion be known at the place where it happens, the difference of time at the place where it is heard will likewiſe give the difference of longitude. Let us next ſuppoſe the mortar to be loaded with an iron ſhell filled with combuſtible matter, and fired perpendicularly upward into the air, the ſhell will be carried to the height of a mile, and will be ſeen at the diſtance of near 100; whence, ſuppoſing neither the flaſh of the mortar ſhould be ſeen nor the report heard, ſtill the longitude might be determined by the altitude of the ſhell above the horizon.

According to this plan, mortars were to be fired at certain times and at proper ſtations along all frequented coaſts for the direction of mariners. This indeed might be of uſe, and in ſtormy weather might be a kind of improvement in lighthouſes, or a proper addition to them; but with regard to the determination of longitudes, is evidently ridiculous.

We ſhall now proceed to give ſome practical directions for finding the longitude at ſea by proper celeſtial obſervations; excluſive of thoſe from Jupiter's ſatellites, which, for reaſons juſt mentioned, cannot be practiſed at ſea. In the firſt place, however, it will be neceſſary to point out ſome of thoſe difficulties which ſtand in the way, and which render even this method of finding the longitude precarious and uncertain. Theſe lie principally in the reduction of the obſervations of the heavenly bodies made on the ſurface of the earth to ſimilar obſervations ſuppoſed to be made at the centre; which is the only place where the celeſtial bodies appear in their proper ſituation. It is alſo very difficult to make proper allowances for the refraction of the atmoſphere, by which all objects appear higher than they really are; and another difficulty ariſes from their parallaxes, which make them, particularly the moon, appear lower than they would otherwiſe do, excepting when they are in the very zenith. It is alſo well known, that the nearer the horizon any celeſtial body is, the greater its parallax will be; and as the parallax and refraction act in oppoſite ways to one another, the former depreſſing and the latter raiſing the object, it is plain, that great difficulties muſt ariſe from this circumſtance. The ſun, for inſtance, whoſe parallax is leſs than the refraction, muſt always appear higher than he really is; but the moon, whoſe parallax is greater than her refraction, muſt always appear lower.

To render obſervations of the celeſtial bodies more eaſy, the commiſſioners of longitude have cauſed an Ephemeris or Nautical Almanack to be publiſhed annually, containing every requiſite for ſolving this important problem which can be put into the form of tables. But whatever may be done in this way, it will be neceſſary to make the neceſſary preparations concerning the dip of the horizon, the refraction, ſemidiameters, parallax, &c. in order to reduce the apparent to the true altitudes and diſtances; for which we ſhall here ſubjoin two general rules.

The principal obſervation for finding the longitude at ſea is that of the moon from the ſun, or from ſome remarkable ſtar near the zodiac. To do this, the operator muſt be furniſhed with a watch which can be depended upon for keeping time within a minute for ſix hours; and with a good Hadley's quadrant, or, which is preferable, a ſextant: and this laſt inſtrument will ſtill be more fit for the purpoſe if it be furniſhed with a ſcrew for moving the index gradually; likewiſe an additional dark glaſs, but not ſo dark as the common kind, for taking off the glare of the moon's light in obſerving her diſtance from a ſtar. A ſmall teleſcope, which may magnify three or four times, is alſo neceſſary to render the contact of a ſtar with the moon's limb more diſcernible. A magnifying glaſs of one

Longitude.

one and a half or two inches focus will likewife affift the operator in reading off his obfervations with the greater facility.

1. *To make the obfervation.* Having examined and adjufted his inftrument as well as poffible, the obferver is next to proceed in the following manner: If the diftance of the moon from the fun is to be obferved, turn down one of the fcreens; look at the moon directly through the tranfparent part of the horizon-glafs; and keeping her in view, gently move the index till the fun's image be brought into the filvered part of that glafs. Bring the neareft limbs of both objects into contact, and let the quadrant librate a little on the lunar ray; by which means the fun will appear to rife and fall by the fide of the moon; in which motion the neareft limbs muft be made to touch one another exactly by moving the index. The obfervation is then made; and the divifion coinciding with that on the Vernier fcale, will fhow the diftance of the neareft limbs of the objects.

When the diftance of the moon from a ftar is to be obferved when the moon is very bright, turn down the lighteft fcreen, or ufe a dark glafs lighter than the fcreens, and defigned for this particular purpofe; look at the ftar directly through the tranfparent part of the horizon-glafs; and keeping it there, move the index till the moon's image is brought into the filvered part of the fame glafs. Make the quadrant librate gently on the ftar's ray, and the moon will appear to rife and fall by the ftar: move the index between the librations, until the moon's enlightened limb is exactly touched by the ftar, and then the obfervation is made. In thefe operations, the plane of the quadrant muft always pafs through the two objects, the diftance of which is to be obferved; and for this purpofe it muft be placed in various pofitions according to the fituation of the objects, which will foon be rendered eafy by practice.

The obfervation being made, fomebody at the very inftant that the operator calls muft obferve by the watch the exact hour, minute, and quarter minute, if there be no fecond hand, in order to find the apparent time; and at the fame inftant, or as quick as poffible, two affiftants muft take the altitudes of thofe objects the diftance of which is obferved; after which, the obfervations neceffary for finding the longitude are completed.

The Ephemeris fhows the moon's diftance from the fun, and likewife from proper ftars, to every three hours of apparent time for the meridian of Greenwich; and that the greater number of opportunities of obferving this luminary may be given, her diftance is generally fet down from at leaft one object on each fide of her. Her diftance from the fun is fet down while it is between 40 and 120 degrees; fo that, by means of a fextant, it may be obferved for two or three days after her firft and before her laft quarter. When the moon is between 40 and 90 degrees from the fun, her diftance is fet down both from the fun and from a ftar on the contrary fide: and, laftly, when the diftance is above 120 degrees, the diftance is fet down from two ftars, one on each fide of her. The diftance of the moon from objects on the eaft fide of her is found in the Ephemeris in the 8th and 9th pages of the month; and her diftance from objects on the weft is found in the 10th and 11th pages of the month.

Longitude.

When the Ephemeris is ufed, the diftance of the moon muft only be obferved from thofe ftars the diftance of which is fet down there; and thefe afford a ready means of knowing the ftar from which her diftance ought to be obferved. The obferver has then nothing more to do than to fet his index to the diftance roughly computed at the apparent time, eftimated nearly for the meridian at Greenwich; after which he is to look to the eaft or weft of the moon, according as the diftance of the ftar is found in the 8th or 9th, or in the 10th or 11th, pages of the month; and having found the moon upon the horizon-glafs, the ftar will eafily be found by fweeping with the quadrant to the right or left, provided the air be clear and the ftar be in the line of the moon's fhorteft axis produced. The time at Greenwich is eftimated by turning into time the fuppofed longitude from that place, and adding it to the apparent time at the fhip, or fubtracting it from it as occafion requires. The diftance of the moon from the fun, or a ftar, is roughly found at this time, by faying, As 180 minutes (the number contained in three hours) is to the difference in minutes between this nearly eftimated time and the next preceding time fet down in the Ephemeris; fo is the difference in minutes between the diftance in the Ephemeris for the next preceding and next following times, to a number of minutes; which being added to the next preceding diftance, or fubtracted from it, according as it is increafing or decreafing, will give the diftance nearly at the time the obfervation is to be made, and to which the index muft be fet.

An eafier method of finding the angular diftance is by bringing the objects nearly into contact in the common way, and then fixing the index tight to a certain degree and minute; waiting until the objects are nearly in contact, giving notice to the affiftants to get ready with the altitudes, and when the objects are exactly in contact to call for the altitudes and the exact time by the watch. The obferver may then prepare for taking another diftance, by fetting his index three or four minutes backwards or forwards, as the objects happen to be receding from or approaching to each other; thus proceeding to take the diftance, altitudes, and time by the watch, as before. Thus the obferver may take as many diftances as he thinks proper; but four at the diftance of three minutes, or three at the diftance of four minutes, will at all times be fufficient. Thus not only the eye of the obferver will be lefs fatigued, but he will likewife be enabled to manage his inftrument with much greater facility in every direction, a vertical one only excepted. If in taking the diftances the middle one can be taken at any even divifion on the arch, fuch as a degree, or a degree and 20 or 40 minutes, that diftance will be independent of the Nonius divifion, and confequently free of thofe errors which frequently arife from the inequality of that divifion in feveral parts of the graduated arch. The obfervation ought always to be made about two hours before or after noon; and the true time may be found by the altitude of the fun taken at the precife time of the diftance. If three diftances are taken, then

then find the time by the altitude correſponding with the middle diſtance; and thus the obſervation will be ſecured from any error ariſing from the irregularity of the going of the watch. As the time, however, found by the altitude of a ſtar cannot be depended upon, becauſe of the uncertainty of the horizon in the night, the beſt way of determining the time for a night obſervation will be by two altitudes of the ſun; one taken on the preceding afternoon, before he is within ſix degrees of the horizon; and the other on the next morning, when he is more than ſix degrees high. It muſt be obſerved, however, that in order to follow theſe directions, it is neceſſary that the atmoſphere ſhould be pretty free from clouds; otherwiſe the obſerver muſt take the obſervations at ſuch times as he can beſt obtain them.

2. *To reduce the obſerved Diſtance of the Sun or a Star from the Moon to the true Diſtance.* 1. Turn the longitude into time, and add it to the time at the ſhip if the longitude be weſt, but ſubtract it if it be eaſt, which will give the ſuppoſed time at Greenwich; and this we may call *reduced time.* 2. Find the neareſt noon or midnight both before and after the reduced time in the ſeventh page of the month in the Ephemeris. 3. Take out the moon's ſemidiameter and horizontal parallaxes correſponding to theſe noons and midnights, and find their differences. Then ſay, As 12 hours is to the moon's ſemidiameter in 12 hours, ſo is the reduced time to a number of ſeconds; which, either added to or ſubtracted from the moon's ſemidiameter at the noon or midnight juſt mentioned, according as it is increaſing or decreaſing, will give her apparent ſemidiameter; to which add the correction from Table VIII. of the Ephemeris, and the ſum will be her true ſemidiameter at the reduced time. And as 12 hours is to the difference of the moon's horizontal parallax in 12 hours, ſo is the reduced time to a fourth number; which, being added to or ſubtracted from the moon's horizontal parallax at the noon or midnight before the reduced time, according as it is increaſing or decreaſing, the ſum or difference will be the moon's horizontal parallax at the reduced time. 4. If the reduced time be nearly any even part of 12 hours, viz. $\frac{1}{3}$th, $\frac{1}{4}$th, &c. theſe parts of the difference may be taken, and either added or ſubtracted according to the directions already given, without being at the trouble of working by the rule of proportion. 5. To the obſerved altitude of the ſun's lower limb add the difference betwixt his ſemidiameter and dip; and that ſum will be his apparent altitude. 6. From the ſun's refraction take his parallax in altitude, and the remainder will be the correction of the ſun's altitude. 7. From the ſtar's obſerved altitude take the dip of the horizon, and the remainder will be the apparent altitude. 8. The refraction of a ſtar will be the correction of its altitude. 9. Take the difference between the moon's ſemidiameter and dip, and add it to the obſerved altitude if her lower limb was taken, or ſubtract it if her upper limb was taken; and the ſum or difference will be the apparent altitude of her centre. 10. From the proportional logarithm of the moon's horizontal parallax, taken out of the nautical almanack (increaſing its index by 10), take the logarithmic coſine of the moon's apparent altitude, the remainder will be the proportional logarithm of her parallax in altitude; from which take her refraction, and the remainder will be the correction of the moon's altitude. 11. To the obſerved diſtance of the moon from a ſtar add her ſemidiameter if the neareſt limb be taken, but ſubtract it if the fartheſt limb was taken, and the ſum or difference will be the apparent diſtance. 12. To the obſerved diſtance of the ſun and moon add both their ſemidiameters, and the ſum will be the apparent diſtance of their centres.

3. *To find the true Diſtance of the Objects, having their apparent Altitudes and Diſtances.* 1. To the proportional logarithm of the correction of the ſun or ſtar's altitude, add the logarithmic coſine of the ſun or ſtar's apparent altitude; the logarithmic ſine of the apparent diſtance of the moon from the ſun or ſtar; and the logarithmic coſecant of the moon's apparent altitude. The ſum of theſe, rejecting 30 from the index, will be the proportional logarithm of the firſt angle. 2. To the proportional logarithm of the correction of the ſun or ſtar's altitude, add the logarithmic cotangent of the ſun or ſtar's apparent altitude, and the logarithmic tangent of the apparent diſtance of the moon from the ſun or ſtar. The ſum of theſe, rejecting 20 in the index, will be the proportional logarithm of the ſecond angle. 3. Take the difference between the firſt and ſecond angles, adding it to the apparent diſtance if it be leſs than 90, and the firſt angle be greater than the ſecond; but ſubtracting it if the ſecond be greater than the firſt. If the diſtance be greater than 90, the ſum of the angles muſt be added to the apparent diſtance, which will give the diſtance corrected for the refraction of the ſun or ſtar. 4. To the proportional logarithm of the correction of the moon's altitude add the logarithmic coſine of her apparent altitude; the logarithmic ſine of the diſtance corrected for the ſun or ſtar's refraction and the logarithmic coſecant of the ſun's or ſtar's apparent altitude. The ſum, rejecting 30 in the index, will be the proportional logarithm of the third angle. 5. To the proportional logarithm of the correction of the moon's apparent altitude, add the logarithmic cotangent of her apparent altitude, and the tangent of the diſtance corrected for the ſun or ſtar's refraction; their ſum, rejecting 20 in the index, will be the proportional logarithm of the fourth angle. 6. Take the difference between the third and fourth angles, and ſubtract it from the diſtance corrected for the ſun or ſtar's refraction if leſs than 90, and the third angle be greater than the fourth; or add it to the diſtance if the fourth angle be greater than the third: but if the diſtance be more than 90, the ſum of the angles muſt be ſubtracted from it, to give the diſtance corrected for the ſun or ſtar's refraction, and the principal effects of the moon's parallax. 7. In Table XX. of the Ephemeris, look for the diſtance corrected for the ſun and ſtar's refraction, and the moon's parallax in the top column, and the correction of her altitude in the left-hand ſide column; take out the number of ſeconds that ſtand under the former, and oppoſite to the latter. Look again in the ſame table for the corrected diſtance in the top column, and the principal effects of the moon's parallax in the left-hand ſide column, and take out the number of ſeconds. The difference between theſe two numbers

numbers muſt be added to the corrected diſtance if leſs than 90, but ſubtracted from it if greater; and the ſum or difference will be the true diſtance.

4. *To determine the Longitude after having obtained the true Diſtance.* Look in the Ephemeris among the diſtances of the objects for the computed diſtance betwixt the moon and the other object obſerved on the given day. If it be found there, the time at Greenwich will be at the top of the column; but if it falls between two diſtances in the Ephemeris which ſtand immediately before and after it, and alſo the difference between the diſtance ſtanding before and the computed diſtance; then take the proportional logarithms of the firſt and ſecond differences, and the difference between theſe two logarithms will be the proportional logarithm of a number of hours, minutes, and ſeconds; which being added to the time ſtanding over the firſt diſtance, will give the true time at Greenwich. Or it may be found by ſaying, As the firſt difference is to three hours, ſo is the ſecond difference to a proportional part of time: which being added as above directed, will give the time at Greenwich. The difference between Greenwich time and that at the ſhip, turned into longitude, will be that at the time the obſervations were made; and will be eaſt if the time at the ſhip is greateſt, but weſt if it is leaſt.

Having given theſe general directions, we ſhall next proceed to ſhow ſome particular examples of finding the longitude at ſea by all the different methods in which it is uſually tried.

1. *To find the Longitude by Computation from the Ship's Courſe.*—Were it poſſible to keep an accurate account of the diſtance the ſhip has run, and to meaſure it exactly by the log * or any other means, then both latitude and longitude would eaſily be found by ſettling the ſhip's account to that time. For the courſe and diſtance being known, the difference of latitude and departure is readily found by the Traverſe Table: and the difference of longitude being known, the true longitude and latitude will alſo be known. A variety of cauſes, however, concur to render this computation inaccurate; particularly the ſhip's continual deflection from the courſe ſet by her playing to the right and left round her centre of gravity: the unequal care of thoſe at the helm, and the diſtance ſuppoſed to be ſailed being erroneous, on account of ſtormy ſeas, unſteady winds, currents, &c. for which it ſeems impoſſible to make any allowance. The place of the ſhip, however, is judged of by finding the latitude every day, if poſſible, by obſervations; and if the latitude found by obſervation agrees with that by the reckoning, it is preſumed that the ſhip's place is properly determined; but if they diſagree, it is concluded that the account of the longitude ſtands in need of correction, as the latitude by obſervation is always to be depended upon.

* See Log, *Perpetual.*

Currents very often occaſion errors in the computation of a ſhip's place. The cauſes of theſe in the great depths of the ocean are not well known, though many of the motions near the ſhore can be accounted for. It is ſuppoſed that ſome of thoſe in the great oceans are owing to the tide following the moon, and a certain libration of the waters ariſing from thence; likewiſe that the unſettled nature of theſe currents may be owing to the changes in the moon's declination. In the torrid zone, however, a conſiderable current is occaſioned by the trade winds, the motion being conſtantly to the weſt, at the rate of eight or ten miles per day. At the extremities of the trade winds or near the 30th degree of north or ſouth latitude, the currents are probably compounded of this motion to the weſtward, and of one towards the equator; whence all ſhips ſailing within theſe limits ought to allow a courſe each day for the current.

When the error is ſuppoſed to have been occaſioned by a current, it ought if poſſible to be tried whether the caſe is ſo or not; or we muſt make a reaſonable eſtimate of its drift and courſe. Then with the ſetting and drift, as a courſe and diſtance, find the difference of latitude and departure; with which the dead reckoning is to be increaſed or diminiſhed; and if the latitude thus corrected agrees with that by obſervation, the departure thus corrected may be ſafely taken as true, and thus the ſhip's place with regard to the longitude determined.

Exam. Suppoſe a ſhip in 24 hours finds, by her dead reckoning, that ſhe has made 96 miles of difference of latitude north and 38 miles of departure weſt; but by obſervation finds her difference of latitude 112, and on trial that there is a current which in 24 hours makes a difference of 16 miles latitude north and 10 miles of departure eaſt: Required the ſhip's departure.

	Miles.		*Miles.*
Diff. lat. by account	96 N.	Departure by account	38 W.
Diff. lat. by current	16 N.	Departure by current	10
True diff. lat.	112		28 W.

Here the dead reckoning corrected by the current gives the difference of latitude 112 miles, which is the ſame as that found by obſervation; whence the departure 28 is taken as the true one.

When the error is ſuppoſed to ariſe from the courſes and diſtances, we muſt obſerve, that if the difference of latitude is much more than the departure, or the direct courſe has been within three points of the meridian, the error is moſt probably in the diſtance. But if the departure be much greater than the difference of latitude, or the direct courſe be within three points of the parallel, or more than five points from the meridian, the error is probably to be aſcribed to the courſe. But if the courſes in general are near the middle of the quadrant, the error may be either in the courſe, or in the diſtance, or both. This method admits of three caſes.

1. When, by the dead reckoning, the difference of latitude is more than once and a half the departure; or when the courſe is leſs than three points: Find the courſe to the difference of latitude and departure. With this courſe and the meridional difference of latitude by obſervation, find the difference of longitude.

2. When the dead reckoning is more than once and a half the difference of latitude; or when the courſe is more than five points: Find the courſe and diſtance, with the difference of latitude by obſervation, and departure by account; then with the co-middle latitude by obſervation, and departure by account, find the difference of longitude.

3. When

Longitude.

3. When the difference of latitude and departure by account is nearly equal, or the direct course is between three and five points of the meridian: Find the course with the difference of latitude and departure by account since the last observation. With this course and the difference of latitude by observation find another departure. Take half the sum of these departures for the true one. With the true departure and difference of latitude by observation find the true course; then with the true course and meridional difference of latitude find the difference of longitude.

2. *To find the Longitude at Sea by a Variation-chart.*—Dr Halley having collected a great number of observations on the variation of the needle in many parts of the world; by that means was enabled to draw certain lines on Mercator's chart, shewing the variation in all the places over which they passed in the year 1700, at which time he first published the chart; whence the longitude of those places might be found by the chart, provided its latitude and variation were given. The rule is, Draw a parallel of latitude on the chart through the latitude found by observation; and the point where it cuts the curved line marked with the variation that was observed will be the ship's place.

Exam. A ship finds by observation the latitude to be 18° 20′ north, and the variation of the compass to be 4° west. Required the ship's place.—Lay a ruler over 18° 20′ north parallel to the equator; and the point where its edge cuts the curve of 4° west variation gives the ship's place, which will be found in about 27° 10′ west from London.

This method of finding the longitude, however, is attended with two inconveniences. 1. That when the variation lines run east or west, or nearly so, it cannot be applied; though as this happens only in certain parts of the world, a variation chart may be of great use for the rest. Even in those places indeed where the variation curves do run east or west, they may be of considerable use in correcting the latitude when meridian observations cannot be had; which frequently happens on the northern coasts of America, the Western ocean, and about Newfoundland; for if the variation can be found exactly, the east and west curve answering to it will show the latitude. But, 2. The variation itself is subject to continual change; whence a chart, though ever so perfect at first, must in time become totally useless; and hence the charts constructed by Dr Halley, though of great utility at their first publication, became at length almost entirely useless. A new one was published in 1746 by Messrs Mountaine and Dodson, which was so well received, that in 1756 they again drew variation lines for that year, and published a third chart the year following. They also presented to the Royal Society a curious paper concerning the variation of the magnetic needle, with a set of tables annexed, containing the result of more than 50,000 observations, in six periodical reviews from the year 1700 to 1756 inclusive, adapted to every five degrees of latitude and longitude in the more frequented oceans; all of which were published in the Philosophical Transactions for 1757.

3. *To find the Longitude by the Sun's Declination.*—Having made such observations on the sun as may enable us to find his declination at the place, take the difference between this computed declination and that shown at London by the Ephemeris; from which take also the daily difference of declination at that time; then say, as the daily difference of declination is to the above found difference, so is 360 degrees to the difference of longitude. In this method, however, a small error in the declination will make a great one in the longitude.

4. *To find the Longitude by the Moon's culminating.*—Seek in the Ephemeris for the time of her coming to the meridian on the given day and on the day following, and take their difference; also take the difference betwixt the times of culminating on the same day as found in the ephemeris and as observed; then say, as the daily difference in the ephemeris is to the difference between the ephemeris and observation; so is 360 degrees to the difference of longitude. In this method also a small difference in the culmination will occasion a great one in the longitude.

5. *By Eclipses of the Moon.*—This is done much in the same manner as by the eclipses of Jupiter's satellites: For if, in two or more distant places where an eclipse of the moon is visible, we carefully observe the times of the beginning and ending, the number of digits eclipsed, or the time when the shadow touches some remarkable spot, or when it leaves any particular spot on the moon, the difference of the times when the observations were made will give the difference of longitude. Phenomena of this kind, however, occur too seldom to be of much use.

6. In the 76th volume of the Philosophical Transactions, Mr Edward Pigot gives a very particular account of his method of determining the longitude and latitude of York; in which he also recommends the method of determining the longitude of places by observations of the *moon's transit over the meridian.* The instruments used in his observations were a gridiron pendulum clock, a two feet and a half reflector, an eighteen inch quadrant made by Mr Bird, and a transit instrument made by Mr Sisson.

By these instruments an observation was made, on the 10th of September 1783, of the occultation of a star of the ninth magnitude by the moon, during an eclipse of that planet, at York and Paris. Besides this, there were observations made of the immersions of φ *Aquarii* and δ *Piscium;* the result of all which was, that between Greenwich and York the difference of meridians was 4′ 27″.

In 1783, Mr Pigot informs us, that he thought of finding the difference of meridians by observing the meridian right ascensions of the moon's limb. This he thought had been quite original: but he found it afterwards in the Nautical Almanack for 1769, and in 1784 read a pamphlet on the same subject by the abbé Toaldo; but still found that the great exactness of this method was not suspected; though he is convinced that it must soon be universally adopted in preference to that from the first satellite of Jupiter.

After giving a number of observations on the satellites of Jupiter, he concludes, that the exactness expected from observations, even on the first satellite, is much over-rated. "Among the various objections (says he), there is one I have often experienced, and which proceeds solely from the disposition of the eye, that of seeing more distinctly at one time than another. It may not be improper also to mention, that the observation I ſhould have relied on as the beſt, that of Auguſt 30. 1785, marked *excellent*, is one of thoſe moſt diſtant from the truth."

After giving a number of obſervations on the eclipſe of the moon September 10. 1783, our author concludes, that the eclipſes of the moon's ſpots are in general too much neglected, and that it might be relied upon much more were the following circumſtances attended to: 1. To be particular in ſpecifying the clearneſs of the ſky. 2. To chooſe ſuch ſpots as are well defined, and leave no heſitation as to the part eclipſed. 3. That every obſerver ſhould uſe, as far as poſſible, teleſcopes equally powerful, or at leaſt let the magnifying powers be the ſame. " A principal objection (ſays he) may ſtill be urged, viz. the difficulty of diſtinguiſhing the true ſhadow from the penumbra. Was this obviated, I believe the reſults would be more exact than from Jupiter's firſt ſatellite: Undoubtedly the ſhadow appears better defined if magnified little; but I am much inclined to think, that, with high magnifying powers, there is greater certainty of chooſing the ſame part of the ſhadow, which perhaps is more than a ſufficient compenſation for the loſs of diſtinctneſs."

The following rule for meridian obſervations of the moon's limb is next laid down: " The increaſe of the moon's right aſcenſion in twelve hours (or any given time found by computation), is to 12 hours as the increaſe of the moon's right aſcenſion between two places found by obſervation is to the difference of meridians.

EXAMPLE.

November 30. 1782.

h. ′ ″		
13 12 57.62	Meridian tranſit of moon's ſecond limb	By clock at Greenwich.
13 13 29.08	Ditto of α ♍	
31.46	Difference of right aſcenſion.	
13 14 8.05	Meridian tranſit of moon's ſecond limb	By clock at York.
13 14 30.13	Ditto of α ♍	
32.08	Difference at York	The clocks going nearly ſidereal time, no correction is required.
31.46	Difference at Greenwich,	
9.38	Increaſe of the moon's apparent right aſcenſion between Greenwich and York, by obſervation.	

141″ in ſeconds of a degree, ditto, ditto, ditto.

The increaſe of the moon's right aſcenſion for 12 hours, by computation, is 23,340 ſeconds; and 12 hours reduced into ſeconds is 43,200. Therefore, according to the rule ſtated above,

23,340″ : 43,200″: diff. of merid.=261″

" Theſe eaſy obſervations and ſhort reduction (ſays Mr Pigot) are the whole of the buſineſs. Inſtead of computing the moon's right aſcenſion for 12 hours, I have conſtantly taken it from the Nautical Almanacks, which give it ſufficiently exact, provided ſome attention be paid to the increaſe or decreaſe of the moon's motion. Were the following circumſtances attended to, the reſults would be undoubtedly much more exact.

" 1. Compare the obſervations with the ſame made in ſeveral other places. 2. Let ſeveral and the ſame ſtars be obſerved at theſe places. 3. Such ſtars as are neareſt in right aſcenſion and declination to the moon are infinitely preferable. 4. It cannot be too ſtrongly urged, to get, as near as poſſible, an equal number of obſervations of each limb, to take a mean of each ſet, and then a mean of both means. This will in a great meaſure correct the error of teleſcopes and ſight. 5. The adjuſtment of the teleſcopes to the eye of the obſerver before the obſervation is alſo very neceſſary, as the ſight is ſubject to vary. 6. A principal error proceeds from the obſervation of the moon's limb, which may be conſiderably leſſened, if certain little round ſpots near each limb were alſo obſerved in ſettled obſervatories; in which caſe the libration of the moon will perhaps be a conſideration. 7. When the difference of meridians, or of the latitudes of places, is very conſiderable, the change of the moon's diameter becomes an equation.

" Though ſuch are the requiſites to uſe this method with advantage, only one or two of them have been employed in the obſervations that I have reduced. Two thirds of theſe obſervations had not even the ſame ſtars obſerved at Greenwich and York; and yet none of the reſults, except a doubtful one, differ 15″ from the mean; therefore I think we may expect a ſtill greater exactneſs, perhaps within 10″, if the above particulars be attended to.

" When the ſame ſtars are not obſerved, it is neceſſary for the obſervers at both places to compute their right aſcenſion from tables, in order to get the apparent right aſcenſion of the moon's limb. Though this is not ſo ſatisfactory as by actual obſervation, ſtill the difference will be trifling, provided the ſtar's right aſcenſions are accurately ſettled. I am alſo of opinion, that the ſame method can be put in practice by travellers with little trouble, and a tranſit inſtrument, conſtructed ſo as to fix up with facility in any place. It is not neceſſary, perhaps, that the inſtrument ſhould be perfectly in the meridian for a few ſeconds of time, provided ſtars, nearly in the ſame parallel of declination with the moon, are obſerved; nay, I am inclined to think, that if the inſtrument deviates even a quarter or half a degree, or more, ſufficient exactneſs can be attained; as a table might be computed, ſhowing the moon's parallax and motion for ſuch deviation; which laſt may eaſily be found by the well-known method of obſerving ſtars whoſe difference of declination is conſiderable.

" As travellers very ſeldom meet with ſituations to obſerve ſtars near the pole, or find a proper object for determining the error of the line of collimation, I ſhall recommend the following method as original.—Having computed the apparent right aſcenſion of four, ſix, or more ſtars, which have nearly the ſame parallel of declination, obſerve half of them with the inſtrument inverted, and the other half when in its right poſition. If the difference of right aſcenſions between each ſet by obſervation agrees with the computation, there is no error; but if they diſagree, half that diſagreement is the error of the line of collimation. The ſame obſervations may alſo ſerve to determine,

Longitude.

mine, whether the diſtances of the correſponding wires are equal. In caſe of neceſſity, each limb of the ſun might be obſerved in the ſame manner, though probably with leſs preciſion. By a ſingle trial I made above two years ago, the reſult was much more exact than I expected. Mayer's catalogue of ſtars will prove of great uſe to thoſe that adopt the above method.—I am rather ſurpriſed that the immerſions of known ſtars of the ſixth and ſeventh magnitude, behind the dark limb of the moon, are not conſtantly obſerved in fixed obſervatories, as they would frequently be of great uſe.

The annexed rule for finding the ſhip's place, with the miſcellaneous obſervations on different methods, were drawn up by Mr John M'Lean of Edinburgh.

1. With regard to determining the ſhip's place by the help of the courſe and diſtance ſailed, the following rule may be applied.—It will be found as expeditious as any of the common methods by the middle latitude or meridional parts; and is in ſome reſpects preferable, as the common tables of ſines and tangents only are requiſite in applying it.—Let a and b be the diſtances of two places from the ſame pole in degrees, or their complete latitude; c the angle which a meridian makes with the rhumb line paſſing through the places; and L the angle formed by their meridians, or the difference of longitude in minutes: then A and B being the logarithmic tangents of $\frac{1}{2}a$ and $\frac{1}{2}b$, S the ſine of C, and S the ſine of $(C+1')$, we ſhall have the following equation: $L=\frac{A\backsim B}{S'-S'}$, (A). Alſo, from a well known property of the rhumb line, we have the following equation:

$S+E=R+D$, where S is the logarithmic coſine of C, E the logarithm of the length of the rhumb line, or diſtance, D the logarithm of the minute's difference of latitude, and R the logarithm of the radius.

By the help of theſe two equations, we ſhall have an eaſy ſolution of the ſeveral caſes to which the middle latitude, or meridional parts, are commonly applied.

EXAM. A ſhip from a port in latitude 56° N. ſails S. W. by W. till ſhe arrives at the latitude of 40° N: Required the difference of longitude?

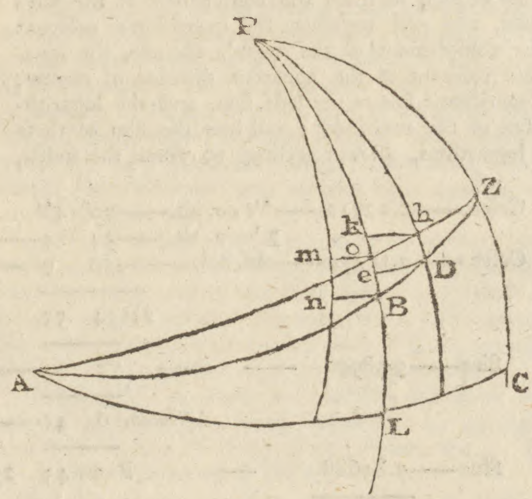
Here $a=34°$, $b=50°$, $c=56°\ 15''$, $A=9.48534$, $B=9.56107$, $S'=9.9199308$, $S=9.9198464$; therefore, $L=\frac{A\backsim B}{S'-S}=\frac{757300}{844}=897$ the minutes difference of longitude. Alſo, $S=9.74474$, $D=2.98227$; therefore $E=R+D-S=3.23753$, to which the natural number is 1728, the miles in the rhumb line ſailed over.

2. The common method of finding the difference of longitude made good upon ſeveral courſes and diſtances, by means of the difference of latitude and departure made good upon the ſeveral courſes, is not accurately true.

For example: If a ſhip ſhould ſail due ſouth 600 miles, from a port in 60° north latitude, and then due weſt 600 miles, the difference of longitude found by the common methods of ſolution would be 1053; whereas the true difference of longitude is only 933, leſs than the former by 120 miles, which is more than one eighth of the whole. Indeed, every conſiderable alteration in the courſe will produce a very ſenſible error in the difference of longitude. Though, when the ſeveral rhumb lines ſailed over are nearly in the ſame direction, the error in longitude will be but ſmall.

Longitude.

The reaſon of this will eaſily appear from the annexed figure, in which the ſhip is ſuppoſed to ſail from Z to A, along the rhumb lines ZB, BA; for if the meridians PZ,PkoeBL be drawn; and very near the latter other two meridians PhD, Pmn; and likewiſe the parallels of latitude Bn, De, mo, hk; then it is plain that De is greater than hk (for De is to hk as the ſine of DP to the ſine of hP): and ſince this is the caſe everywhere, the departure correſponding to the diſtance BZ and courſe BZC, will be greater than the departure to the diſtance oZ and courſe oZC. And in the ſame manner, we prove that nB is greater than mo; and conſequently, the departure correſponding to the diſtance AB, and courſe ABL, is greater than the departure to the diſtance Ao, and courſe AoL. Wherefore, the ſum of the two departures correſponding to the courſes ABL and BZC, and to the diſtances AB and BZ, is greater than the departure correſponding to the diſtance AZ and courſe AZC: therefore the courſe anſwering to this ſum as a departure, and CZ as a difference of latitude, (AC being the parallel of latitudes paſſing through A), will be greater than the true courſe AZC made good upon the whole. And hence the difference of longitude found by the common rules will be greater then the true difference of longitudes; and the error will be greater or leſs according as BA deviates more or leſs from the direction of BZ.



3. Of determining the ſhip's longitude by lunar obſervations.

Several rules for this purpoſe have been lately publiſhed, the principal object of which ſeems to have been to

(A) A∽B ſignifies the difference between A and B.

Longitude.

to abbreviate the computations requisite for determining the true distance of the sun or star from the moon's centre. This, however, should have certainly been less attended to than the investigation of a solution, in which considerable errors in the data may produce a small error in the required distance. When either of the luminaries has a small elevation, its altitude will be affected by the variableness of the atmosphere; likewise the altitude, as given by the quadrant, will be affected by the inaccuracy of the instrument, and the uncertainty necessarily attending all observations made at sea. The sum of these errors, when they all tend the same way, may be supposed to amount to at least one minute in altitude; which, in many cases, according to the common rules for computing the true distance, will produce an error of about 30 minutes in the longitude. Thus, in the example given by Monf. Callet, in the *Tables Portatives*, if we suppose an error of one minute in the sun's altitude, or call it 6° 26′ 34″, instead of 6° 27′ 34″; we shall find the alteration in distance according to his rule to be 54″, producing an error of about 27 minutes in the longitude; for the angle at the sun will be found, in the spherical triangle whose sides are the complement of the sun's altitude, complement of the moon's altitude, and observed distance, to be about 26°; and as radius is to the cosine of 26°, so is 16 the supposed error in altitude, to 54″ the alteration in distance. Perhaps the only method of determining the distance, so as not to be affected by the errors of altitude, is that by first finding the angles at the sun and moon, and by the help of them the corrections of distance for parallax and refraction. The rule is as follows:

Add together the complement of the moon's apparent altitude, the complement of the sun's apparent altitude, and the apparent distance of centres; from half the sum of these substract the complement of the sun's altitude, and add together the logarithmic cosecant of the complement of the moon's altitude, the logarithmic cosecant of the apparent distance of centres, the logarithmic sine of the half sum, and the logarithmic sine of the remainder; and half the sum of these four logarithms, after rejecting 20 from the index, is the logarithmic cosine of half the angle at the moon.

Longitude.

As radius is to the cosine of the angle at the moon; so is the difference between the moon's parallax and refraction in altitude to a correction of distance; which is to be added to the apparent distance of centres when the angle at the moon is obtuse; but to be subtracted when that angle is acute, in order to have the distance once corrected.

In the above formula, if the word *sun* be changed for *moon*, and *vice versa*, wherever these terms occur, we shall find a second correction of distance to be applied to the distance, once corrected by subtraction when the angle at the sun is obtuse, but by addition when that angle is acute, and the remainder or sum is the true distance nearly.

In applying this rule, it will be sufficient to use the complement, altitude, and apparent distances of centres, true to the nearest minute only, as a small error in the angles at the sun and moon will very little affect the corrections of distances.

If D be the computed distance in seconds, d the difference between the moon's parallax and refraction in altitude, S the sine of the angle at the moon, and R the radius; then $\frac{d^2 S^2}{2DR}$ will be the third correction of distance, to be added to the distance twice corrected: But it is plain, from the nature of this correction, that it may be always rejected, except when the distance D is very small, and the angle at the moon nearly equal to 90°.

This solution is likewise of use in finding the true distance of a star from the moon, by changing the word *sun* into *star*, and using the refraction of the star, instead of the difference between the refraction and parallax in altitude of the sun, in finding the second correction of distance.

Ex. Given the observed distance of a star from the centre of the moon, 50° 8′ 41″; the moon's altitude, 55° 58′ 5″; the star's altitude, 19° 18′ 5″; and the moon's horizontal parallax, 1° 0′ 5″: Required the true distance.

Cosec.——0.02512——*'s co. alt.——70° 42′
☽'s co. alt.——34 4——Cosec.——0.25169
Cosec.——0.11479——obs. dist.——50 9——Cosec.——0.11479

2)154 55

Sine——9.98950 —— —— 77 27——Sine——9.98950

Rem. 6 45——Sine——9.07018

Sine——9.83688 —— Rem. 43 23 2)19.42616

2)19.96629 ——Cosec.——9.71308——58° 54′
2

Cosec.——9.98314—— 15° 54′——
2

117 48 = ☽'s angle.

31 48 = *'s angle.

Rad. : Cosec. 117° 48′ : : ☽'s diff. parall. & refract. 1980″ : 923″ = 1st correct. of distance.
Rad. · Cosec. 31° 48′ : star's refract. 162″ : 138″ = 2d correct. of distance.

3 Here

Here the first correction of distance is additive, since the angle at the moon is obtuse; and the second correction is also additive, since the angle at the star is acute: therefore their sum $923''+138''=1061''=17' 41''$, being added to $50° 8' 41''$, the apparent distance of the star from the moon's centre, gives $50° 26' 21''$ for the true distance of centres nearly;—and $2\times L (d+S)-L (2 L R+L 2+L D)=L 8''$, which, being added to the distance twice corrected, gives $50° 26' 29''$ for the true distance. By comparing this distance with the computed distances in the ephemeris, the time at Greenwich corresponding to that of observing the distance will be known; and the difference of those times being converted into degrees and minutes, at the rate of 15 degrees to the hour, will give the longitude of the place of observation; which will be east if the time at the place be greater than that at Greenwich, but west if it be less.

LONGITUDINAL, in general, denotes something placed lengthwise: thus some of the fibres in the vessels of the human body are placed longitudinally, others transversely or across.

LONGOBARDI. See LOMBARDS.

LONGOMONTANUS, CHRISTIAN, a learned astronomer, born in a village of Denmark in 1562. He was the son of a ploughman; and was obliged to suffer during his studies all the hardships to which he could be exposed, dividing his time, like the philosopher Cleanthes, between the cultivation of the earth and the lessons he received from the minister of the place. At last, when he was 15, he stole away from his family, and went to Wiburg, where there was a college, in which he spent 11 years; and though he was obliged to earn a livelihood, he applied himself to study with such ardour, that among other sciences he learned the mathematics in great perfection. He afterwards went to Copenhagen; where the professors of that university in a short time conceived so high an opinion of him, that they recommended him to the celebrated Tycho Brahe. Longomontanus lived eight years with that famous astronomer, and was of great service to him in his observations and calculations. At length, being extremely desirous of obtaining a professor's chair in Denmark, Tycho Brahe consented, though with some difficulty, to deprive himself of his service; gave him a discharge, filled with the highest testimonies of his esteem; and furnished him with money for the expence of his long journey. He obtained a professorship of mathematics in the university of Copenhagen in 1605; and discharged the duty of it worthily till his death, which happened in 1647. He wrote many learned works; amused himself with endeavouring to square the circle, and pretended that he had made that discovery; but Dr John Pell, an English mathematician, attacked him warmly on that subject, and proved that he was mistaken.

LONGTOWN, a town of Cumberland, on the Scots borders, near the conflux of the Esk and Kirksop, 10 miles from Carlisle, and 313 miles from London; it has a market on Thursday, and a charity school for 60 children, with two fairs in the year.

LONGUEVILLE, a town of France, in the department of Lower Seine, and in the territory of Caux, seated on the small river Lee, 17 miles north of Rouen. It has the title of a duchy. E. Long. 1. 10. N. Lat. 49. 46.

LONGWY, a town of France, in the department of Moselle, with a castle, divided into the old and new towns. This last was built and fortified by Louis XIV. It is seated on an eminence. It was taken by the king of Prussia in 1792, but retaken two months after. E. Long. 5. 58. N. Lat. 49. 32.

LONGUS, a Greek sophist, author of a book entitled Ποιμενικα, or Pastorals, or a romance containing the loves of Daphnis and Chloe. Huetius, bishop of Avranches, speaks very advantageously of this work; but he censures the obscene touches with which it is interspersed. None of the ancient authors mention him, so that the time when he lived cannot be certainly fixed. There is an English translation of this author, which is ascribed to Mr J. Craggs, once secretary of state.

LONICERA, HONEYSUCKLE, a genus of plants belonging to the pentandria class. See BOTANY *Index*.

LONSDALE, or *Kirkby* LONSDALE, a town of Westmorland, seated on the river Lon, in a pleasant and rich valley of the same name. It is a large well built town, has a handsome church, and a fine stone bridge over the river. It is well inhabited; and is the best town in the county except Kendal. It gives title of earl to the Lowther family. W. Long. 2. 27. N. Lat. 54. 10.

LOO, a town of the United Provinces, in Guelderland, eight miles west of Deventer, where the prince of Orange has a fine palace. E. Long. 6. 0. N. Lat. 52. 18.

LOOF, the after part of a ship's bow; or that part of her side forward where the planks begin to be incurvated into an arch as they approach the stem.

LOOF, or *Luff.* See LUFF.

LOOK-OUT, in the sea-language, a watchful attention to some important object or event which is expected to arise from the present situation of a ship, &c. It is principally used in navigation when there is a probability of danger from the real or supposed proximity of land, rocks, enemies, and, in short, whatever peril she may encounter through inattention, which might otherwise have been avoided by a prudent and necessary vigilance.

There is always a look-out kept on a ship's forecastle at sea, to watch for any dangerous objects lying near her track, and to which she makes a gradual approach as she advances: the mate of the watch accordingly calls often from the quarter-deck, "Look out afore there!" to the persons appointed for this service.

LOOKING-GLASSES, are nothing but plain mirrors of glass; which, being impervious to the light, reflect the images of things placed before them. See the articles MIRROR and OPTICS.

For the casting, grinding, and polishing of looking-glasses, see the article GLASS.

For foliating of looking-glasses. See the article FOLIATING.

LOOL, in *Metallurgy*, a vessel made to receive the washings of ores of metals. The heavier or more metalline parts of the ores remain in the trough in which they are washed; the lighter and more earthy run off with the water, but settle in the lool.

LOOM, the weaver's frame; a machine whereby feveral diftinct threads are woven into one piece.

Looms are of various ftructures, accommodated to the various kinds of materials to be woven, and the various manner of weaving them; viz. for woollens, filks, linens, cottons, cloths of gold, and other works, as tapeftry, ribbands, ftockings, &c. divers of which will be found under their proper heads. See WEAVING.

The weaver's loom-engine, otherwife called the Dutch loom-engine, was brought into ufe from Holland to London, in or about the year 1676.

Heir-Loom, in *Law*. See *Heir-Loom*.

LOOM, at fea. If a fhip appears big, when at a diftance, they fay fhe looms, or appears a great fail: the term is alfo ufed to denote the indiftinct appearance of any other diftant objects.

Loom-gale, at fea, a gentle eafy gale of wind, in which a fhip can carry her top-fails a-trip.

LOOP, in the iron works, is a part of a fow or block of caft iron broken or melted off from the reft, and prepared for the forge or hammer. The ufual method is, to break off the loop of about three quarters of a hundred weight. This loop they take up with their flinging-tongs, and beat it with iron fledges upon an iron plate near the fire, that fo it may not fall to pieces, but be in a condition to be carried under the hammer. It is then placed under the hammer, and a little water being drawn to make the hammer move but foftly, it is beat very gently, and by this means the drofs and foulnefs are forced off; and after this they draw more and more water by degrees, and beat it more and more till they bring it to a four-fquare mafs, of about two feet long, which they call a bloom.

LOOPING, in *Metallurgy*, a word ufed by the miners of fome counties of England, to exprefs the running together of the matter of an ore into a mafs, in the roafting or firft burning, intended only to calcine it fo far as to make it fit for powdering. This accident, which gives the miners fome trouble, is generally owing to the continuing the fire too long in this procefs.

LOOSE-STRIFE. See LYSIMACHIA, BOTANY *Index*.

LOPEZ DE VEGA. See VEGA.

LOPEZ, or *Indian Root*, in the *Materia Medica*. The plant to which this article belongs is unknown. Neither the woody nor cortical part of the root has any remarkable fenfible quality. A flight bitternefs is perceptible; and it is recommended, like fimarouba, in diarrhœas even of the colliquative kind, in half-dram dofes four times a-day. Little of this root has been brought to Europe: but fome of thofe who have had an opportunity of employing it, fpeak in very high terms of the effects obtained from it.

LOPHIUS, FISHING-FROG, *Toad fifh*, or *Sea-devil*; a genus of the branchioftegous order of fifhes. See ICHTHYOLOGY *Index*.

LORANTHUS, a genus of plants belonging to the hexandria clafs, and in the natural method ranking under the 48th order, *Aggregatæ*. See BOTANY *Index*.

LORARII, among the Romans, officers whofe bufinefs it was, with whips and fcourges, to compel the gladiators to engage. The *lorarii* alfo punifhed flaves who difobeyed their mafters.

LORD, a title of honour given to thofe who are noble either by birth or creation. In this fenfe, it amounts to much the fame as *peer of the realm*, or *lord of parliament*. The title is by courtefy alfo given to all the fons of dukes and marquifes, and to the eldeft fons of earls: and it is alfo a title of honour beftowed on thofe who are honourable by their employments; as *lord advocate*, *lord chamberlain*, *lord chancellor*, *&c*. The word is Saxon, but abbreviated from two fyllables into one; for it was originally *Hlaford*, which by dropping the afpiration became *Laford*, and afterwards by contraction *Lord*. "The etymology of the word (fays J. Coates) is well worth obferving; for it was compofed of *hlaf* "a loaf of bread," and *ford* "to give or afford;" fo that *Hlaford*, now *Lord*, implies "a giver of bread;" becaufe, in thofe ages, fuch great men kept extraordinary houfes, and fed all the poor; for which reafon they were called *givers of bread*, a thing now much out of date, great men being fond of retaining the title, but few regarding the practice for which it was firft given. See LADY.

Houfe of LORDS, one of the three eftates of parliament, and compofed of the Lords Spiritual and Temporal.

1. The *Spiritual Lords* confift of two archbifhops and 24 bifhops; and, at the diffolution of monafteries by Henry VIII. confifted likewife of 26 mitred abbots and two priors; a very confiderable body, and in thofe times equal in number to the temporal nobility. All thefe hold, or are fuppofed to hold, certain ancient baronies under the king: for William the Conqueror thought proper to change the fpiritual tenor of frank-almoign or free alms, under which the bifhops held their lands during the Saxon government, into the feodal or Norman tenure by barony; which fubjected their eftates to all civil charges and affeffments, from which they were before exempt; and in right of fucceffion to thofe baronies, which were unalienable from their refpective dignities, the bifhops and abbots were allowed their feats in the houfe of lords. But though thefe lords fpiritual are in the eye of the law a diftinct eftate from the lords temporal, and are fo diftinguifhed in moft of our acts of parliament; yet in practice they are ufually blended together under the name of *the lords*: they intermix in their votes, and the majority of fuch intermixture joins both eftates. And from this want of a feparate affembly, and feparate negative of the prelates, fome writers have argued very cogently, that the lords fpiritual and temporal are now in reality only one eftate: which is unqueftionably true in every effectual fenfe, though the ancient diftinction between them ftill nominally continues. For if a bill fhould pafs their houfe, there is no doubt of its validity, though every lord fpiritual fhould vote againft it; of which Selden and Sir Edward Coke give many inftances: as, on the other hand, doubtlefs it would be equally good, if the lords temporal prefent were inferior to the bifhops in number, and every one of thofe temporal lords gave his vote to reject the bill; though this Sir Edward Coke feems to doubt of.

2. The *Temporal Lords* confift of all the peers of the realm (the bifhops not being in ftrictnefs held to be fuch, but merely lords of parliament), by whatever title of nobility diftinguifhed; dukes, marquifes, earls, vifcounts or barons *. Some of thefe fit by defcent, as do all ancient peers; fome by creation, as do all new

* See *Nobility*.

new made ones; others, ſince the union with Scotland, by election, which is the caſe of the 16 peers who repreſent the body of the Scots nobility. Their number is indefinite, and may be increaſed at will by the power of the crown: and once, in the reign of Queen Anne, there was an inſtance of creating no leſs than 12 together; in contemplation of which, in the reign of King George I. a bill paſſed the houſe of lords, and was countenanced by the then miniſtry, for limiting the number of the peerage. This was thought by ſome to promiſe a great acquiſition to the conſtitution, by reſtraining the prerogative from gaining the aſcendant in that auguſt aſſembly, by pouring in at pleaſure an unlimited number of new-created lords. But the bill was ill reliſhed, and miſcarried in the houſe of commons, whoſe leading members were then deſirous to keep the avenues to the other houſe as open and eaſy as poſſible.

The diſtinction of ranks and honours is neceſſary in every well governed ſtate: in order to reward ſuch as are eminent for their ſervices to the public, in a manner the moſt deſirable to individuals, and yet without burden to the community; exciting thereby an ambitious yet laudable ardour and generous emulation in others. And emulation, or virtuous ambition, is a ſpring of action which, however dangerous or invidious in a mere republic or under a deſpotic ſway, will certainly be attended with good effects under a free monarchy; where, without deſtroying its exiſtence, its exceſſes may be continually reſtrained by that ſuperior power from which all honour is derived. Such a ſpirit, when nationally diffuſed, gives life and vigour to the community; it ſets all the wheels of government in motion, which, under a wiſe regulator, may be directed to any beneficial purpoſe; and thereby every individual may be made ſubſervient to the public good, while he principally means to promote his own particular views. A body of nobility is alſo more particularly neceſſary in our mixed and compounded conſtitution, in order to ſupport the rights of both the crown and the people, by forming a barrier to withſtand the encroachments of both. It creates and preſerves that gradual ſcale of dignity which proceeds from the peaſant to the prince; riſing like a pyramid from a broad foundation, and diminiſhing to a point as it riſes. It is this aſcending and contracting proportion that adds ſtability to any government; for when the departure is ſudden from one extreme to another, we may pronounce that ſtate to be precarious. The nobility therefore are the pillars, which are reared from among the people, more immediately to ſupport the throne; and, if that falls, they muſt alſo be buried under its ruins. Accordingly, when in the laſt century the commons had determined to extirpate monarchy, they alſo voted the houſe of lords to be uſeleſs and dangerous. And ſince titles of nobility are thus expedient in the ſtate, it is alſo expedient that their owners ſhould form an independent and ſeparate branch of the legiſlature. If they were confounded with the maſs of the people, and like them had only a vote in electing repreſentatives, their privileges would ſoon be borne down and overwhelmed by the popular torrent, which would effectually level all diſtinctions. It is therefore highly neceſſary that the body of nobles ſhould have a diſtinct aſſembly, diſtinct deliberations, and diſtinct powers from the commons. See alſo KING, NOBILITY, PARLIAMENT, COMMONS, and COMMONALTY.

As to the peculiar laws and cuſtoms relating to the houſe of lords: One very ancient privilege is that declared by the charter of the foreſt, confirmed in parliament 9 Hen. III.; viz. that every lord ſpiritual or temporal ſummoned to parliament, and paſſing through the king's foreſts, may, both in going and returning, kill one or two of the king's deer without warrant; in view of the foreſter if he be preſent, or on blowing a horn if he be abſent; that he may not ſeem to take the king's veniſon by ſtealth.

In the next place, they have a right to be attended, and conſtantly are, by the judges of the court of king's bench and common pleas, and ſuch of the barons of the exchequer as are of the degree of the coif, or have been made ſerjeants at law; as likewiſe by the king's learned counſel, being ſerjeants, and by the maſters of the court of chancery; for their advice in point of law, and for the greater dignity of their proceedings. The ſecretaries of ſtate, with the attorney and ſolicitor general, were alſo uſed to attend the houſe of peers, and have to this day (together with the judges, &c.) their regular writs of ſummons iſſued out at the beginning of every parliament, *ad tractandum et conſilium impendendum*, though not *ad conſentiendum*, but, whenever of late years they have been members of the houſe of commons, their attendance here hath fallen into diſuſe.

Another privilege is, that every peer, by licenſe obtained from the king, may make another lord of parliament his proxy, to vote for him in his abſence: A privilege, which a member of the other houſe can by no means have, as he is himſelf but a proxy for a multitude of other people.

Each peer has alſo a right, by leave of the houſe, when a vote paſſes contrary to his ſentiments, to enter his diſſent on the journals of the houſe, with the reaſons for ſuch diſſent; which is uſually ſtyled his proteſt.

All bills likewiſe, that may in their conſequences any way affect the rights of the peerage, are by the cuſtom of parliament to have their firſt riſe and beginning in the houſe of peers, and to ſuffer no changes or amendments in the houſe of commons.

There is alſo one ſtatute peculiarly relative to the houſe of lords; 6 Ann. c. 23. which regulates the election of the 16 repreſentative peers of North Britain, in conſequence of the 22d and 23d articles of the Union: and for that purpoſe preſcribes the oaths, &c. to be taken by the electors; directs the mode of balloting; prohibits the peers electing from being attended in an unuſual manner; and expreſsly provides, that no other matter ſhall be treated of in that aſſembly, ſave only the election, on pain of incurring a præmunire. See alſo the articles NOBILITY and PEERS.

LORDOSIS, (of λορδος, *bent inwards*), in the medical writings, a name given to a diſtempered ſtate of the ſpine, in which it is bent inwards, or towards the anterior parts. It is uſed in oppoſition to *gibbous*, or *hump-backed*. See SURGERY.

LORETTO, a town of Italy, in the Marca or Marche of Ancona, with a biſhop's ſee. It is ſmall but fortified; and contains the famous *caſa ſanta*, or holy

Loretto. holy chapel, ſo much viſited by pilgrims. This chapel, according to the legend, was originally a ſmall houſe in Nazareth, inhabited by the virgin Mary, in which ſhe was ſaluted by the angel, and where ſhe bred our Saviour. After their deaths, it was held in great veneration by all believers in Jeſus, and at length conſecrated into a chapel, and dedicated to the Virgin; upon which occaſion St Luke made that identical image, which is ſtill preſerved here, and dignified with the name of our Lady of Loretto. This ſanctified edifice was allowed to ſojourn in Galilee as long as that diſtrict was inhabited by Chriſtians; but when infidels got poſſeſſion of the country, a band of angels, to ſave it from pollution, took it in their arms, and conveyed it from Nazareth to a caſtle in Dalmatia. This fact might have been called in queſtion by incredulous people, had it been performed in a ſecret manner; but, that it might be manifeſt to the moſt ſhort-ſighted ſpectator, and evident to all who were not perfectly deaf as well as blind, a blaze of celeſtial light, and a concert of divine muſic, accompanied it during the whole journey; beſides, when the angels, to reſt themſelves, ſet it down in a little wood near the road, all the trees of the foreſt bowed their heads to the ground, and continued in that reſpectful poſture as long as the ſacred chapel remained among them. But not having been entertained with ſuitable reſpect at the caſtle above mentioned, the ſame indefatigable angels carried it over the ſea, and placed it in a field belonging to a noble lady called *Lauretta*, from whom the chapel takes its name. This field happened unfortunately to be frequented at that time by highwaymen and murderers: a circumſtance with which the angels undoubtedly were not acquainted when they placed it there. After they were better informed they removed it to the top of a hill belonging to two brothers, where they imagined it would be perfectly ſecure from the dangers of robbery or aſſaſſination; but the two brothers, the proprietors of the ground, being equally enamoured of their new viſitor, became jealous of each other, quarrelled, fought, and fell by mutual wounds. After this fatal cataſtrophe, the angels in waiting finally moved the holy chapel to the eminence where it now ſtands, and has ſtood theſe 400 years, having loſt all reliſh for travelling.

The ſacred chapel ſtands due eaſt and weſt, at the farther end of a large church of the moſt durable ſtone of Iſtria, which has been built around it. This may be conſidered as the external covering, or as a kind of great coat to the *caſa ſanta*, which has a ſmaller coat of more precious materials and workmanſhip nearer its body. This internal covering or caſe is of the choiceſt marble, after a plan of San Savino's, and ornamented with baſſo relievos, the workmanſhip of the beſt ſculptors which Italy could furniſh in the reign of Leo X. The ſubject of theſe baſſo relievos are the hiſtory of the Bleſſed Virgin, and other parts of the Bible. The whole caſe is about 50 feet long, 30 in breadth, and the ſame in height: but the real houſe itſelf is no more than 32 feet in length, 14 in breadth, and at the ſides about 18 feet in height; the centre of the roof is four or five feet higher. The walls of this little holy chapel are compoſed of pieces of a reddiſh ſubſtance, of an oblong ſquare ſhape, laid one upon another, in the manner of brick. At firſt ſight, on a ſuperficial view, theſe red-coloured oblong ſubſtances appear to be nothing elſe than common Italian bricks; and, which is ſtill more extraordinary, on a ſecond and third view, with all poſſible attention, they ſtill have the ſame appearance. Travellers, however, are aſſured with great earneſtneſs, that there is not a ſingle particle of brick in their whole compoſition, being entirely of a ſtone, which, though it cannot now be found in Paleſtine, was formerly very common, particularly in the neighbourhood of Nazareth. Loretto.

The holy houſe is divided within into two unequal portions, by a kind of grate-work of ſilver. The diviſion towards the weſt is about three fourths of the whole; that to the eaſt is called the *Sanctuary*. In the larger diviſion, which may be conſidered as the main body of the houſe, the walls are left bare, to ſhow the true original fabric of Nazareth ſtone; for they muſt not be ſuppoſed to be bricks. At the lower or weſtern wall there is a window, the ſame through which the angel Gabriel entered at the Annunciation. The architraves of this window are covered with ſilver. There are a great number of golden and ſilver lamps in this chapel: one of the former, a preſent from the republic of Venice, is ſaid to weigh 37 pounds, and ſome of the ſilver lamps weigh from 120 to 130 pounds. At the upper end of the largeſt room is an altar, but ſo low, that from it you may ſee the famous image which ſtands over the chimney in the ſmall room or ſanctuary. Golden and ſilver angels, of conſiderable ſize, kneel around her, ſome offering hearts of gold, enriched with diamonds, and one an infant of pure gold. The wall of the ſanctuary is plated with ſilver, and adorned with crucifixes, precious ſtones, and votive gifts of various kinds. The figure of the Virgin herſelf by no means correſponds with the fine furniture of her houſe: She is a little woman, about four feet in height, with the features and complexion of a negro. Of all the ſculptors that ever exiſted, aſſuredly St Luke, by whom this figure is ſaid to have been made, is the leaſt of a flatterer; and nothing can be a ſtronger proof of the Bleſſed Virgin's contempt for external beauty than her being ſatisfied with this repreſentation of her. The figure of the infant Jeſus, by St Luke, is of a piece with that of the Virgin: he holds a large golden globe in one hand, and the other is extended in the act of bleſſing. Both figures have crowns on their heads, enriched with diamonds: theſe were preſents from Ann of Auſtria, queen of France. Both arms of the Virgin are encloſed within her robes, and no part but her face is to be ſeen; her dreſs is moſt magnificent, but in a wretched bad taſte: this is not ſurpriſing, for ſhe has no female attendant. She has particular clothes for the different feaſts held in honour of her, and, which is not quite ſo decent, is always dreſſed and undreſſed by the prieſts belonging to the chapel; her robes are ornamented with all kinds of precious ſtones down to the hem of her garment.

There is a ſmall place behind the ſanctuary, in which are ſhown the chimney, and ſome other furniture, which they pretend belonged to the Virgin when ſhe lived at Nazareth; particularly a little earthen porringer, out of which the infant uſed to eat. The pilgrims bring roſaries, little crucifixes, and agnus dei's, which the obliging prieſt ſhakes for half a minute

Loretto. nute in this diſh; after which it is believed they acquire the virtue of curing various diſeaſes, and prove an excellent preventive of all temptations of Satan. The gown which the image had on when the chapel arrived from Nazareth is of red camblet, and carefully kept in a glaſs ſhrine.

Above 100 maſſes are daily ſaid in this chapel, and in the church in which it ſtands. The jewels and riches to be ſeen at any one time in the holy chapel are of ſmall value in compariſon of thoſe in the treaſury, which is a large room adjoining to the veſtry of the great church. In the preſſes of this room are kept thoſe preſents which royal, noble, and rich bigots of all ranks, have, by oppreſſing their ſubjects and injuring their families, ſent to this place. To enumerate every particular would fill volumes. They conſiſt of various utenſils and other things in ſilver and gold; as lamps, candleſticks, goblets, crowns, and crucifixes; lambs, eagles, ſaints, apoſtles, angels, virgins, and infants: then there are cameos, pearls, gems, and precious ſtones, of all kinds and in great numbers. What is valued above all the other jewels is, the miraculous pearl, wherein they aſſert that Nature has given a faithful delineation of the Virgin ſitting on a cloud with the infant Jeſus in her arms. There was not room in the preſſes of the treaſury to hold all the ſilver pieces which had been preſented to the Virgin. Several other preſſes in the veſtry are completely full. It is ſaid that thoſe pieces are occaſionally melted down by his holineſs for the uſe of the ſtate: and alſo that the moſt precious of the jewels are picked out and ſold for the ſame purpoſe, falſe ſtones being ſubſtituted in their room.

Pilgrimages to Loretto are not ſo frequent with foreigners, or with Italians of fortune and diſtinction, as formerly; nineteen out of twenty of thoſe who make this journey now are poor people, who depend for their maintenance on the charity they receive on the road. To thoſe who are in ſuch a rank in life as precludes them from availing themſelves of the charitable inſtitutions for the maintenance of pilgrims, ſuch journeys are attended with expence and inconveniency; and fathers and huſbands, in moderate or confined circumſtances, are frequently brought to diſagreeable dilemmas, by the raſh vows of going to Loretto which their wives or daughters are apt to make on any ſuppoſed deliverance from danger. To refuſe, is conſidered by the whole neighbourhood as cruel, and even impious; and to grant, is often highly diſtreſſing, particularly to ſuch huſbands as, from affection or any other motives, do not chooſe that their wives ſhould be long out of their ſight. But the poor, who are maintained during their whole journey, and have nothing more than a bare maintenance to expect from their labour at home, to them a journey to Loretto is a party of pleaſure as well as devotion, and by much the moſt agreeable road they can take to heaven. The greateſt concourſe of pilgrims is at the ſeaſons of Eaſter and Whitſuntide. The rich travel in their carriages: A greater number come on horſeback or on mules; or, what is ſtill more common, on aſſes. Great numbers of females come in this manner, with a male friend walking by them as their guide and protector: but the greateſt number of both ſexes are on foot. The pilgrims on foot, as ſoon as they enter the ſuburbs, begin a hymn in honour of the Virgin, which they continue till they reach the church. The poorer ſort are received into an hoſpital, where they have bed and board for three days.

The only trade of Loretto conſiſts of roſaries, crucifixes, little madonas, agnus dei's, and medals, which are manufactured here, and ſold to pilgrims. There are great numbers of ſhops full of theſe commodities, ſome of them of a high price; but infinitely the greater part are adapted to the purſes of the buyers, and ſold for a mere trifle. The evident poverty of thoſe manufacturers and traders, and of the inhabitants of this town in general, is a ſufficient proof that the reputation of our Lady of Loretto is greatly on the decline.

In the great church which contains the holy chapel are confeſſionals, where the penitents from every country of Europe may be confeſſed in their own language, prieſts being always in waiting for that purpoſe: each of them has a long white rod in his hand, with which he touches the heads of thoſe to whom he thinks it proper to give abſolution. They place themſelves on their knees in groupes around the confeſſional chair; and when the holy father has touched their heads with the expiatory rod, they retire, freed from the burden of their ſins, and with renewed courage to begin a freſh account.

In the ſpacious area before this church there is an elegant marble fountain, ſupplied with water from an adjoining hill by an aqueduct. Few even of the moſt inconſiderable towns of Italy are without the uſeful ornament of a public fountain. The embelliſhments of ſculpture and architecture are employed with great propriety on ſuch works, which are continually in the people's view; the air is refreſhed and the eye delighted by the ſtreams of water they pour forth; a ſight peculiarly agreeable in a warm climate. In this area there is alſo a ſtatue of Sixtus V. in bronze. Over the portal of the church itſelf is a ſtatue of the Virgin; and above the middle gate is a Latin inſcription, importing that within is the houſe of the mother of God, in which the Word was made fleſh. The gates of the church are likewiſe of bronze, embelliſhed with baſſo relievos of admirable workmanſhip: the ſubjects taken partly from the Old and partly from the New Teſtament, and divided into different compartments. As the gates of this church are ſhut at noon, the pilgrims who arrive after that time can get no nearer the *ſanta caſa* than theſe gates, which are by this means ſometimes expoſed to the firſt violence of that holy ardour which was deſigned for the chapel itſelf. All the ſculpture upon the gates which is within reach of the mouths of thoſe zealots, is in ſome degree effaced by their kiſſes.

There are alſo ſeveral paintings to be ſeen here, ſome of which are highly eſteemed, particularly two in the treaſury. The ſubject of one of theſe is the Virgin's Nativity, by Annibal Caracci; and of the other, a Holy Family by Raphael. There are ſome others of conſiderable merit which ornament the altars of the great church. Theſe altars, or little chapels, of which this fabric contains a great number, are lined with marble and embelliſhed by ſculpture; but nothing within this church intereſts a traveller of ſenſibility ſo much as the iron grates before thoſe chapels, which

 were

were made of the fetters and chains of the Christian ſlaves, who were freed from bondage by the glorious victory of Lepanto.

The palace where the governor reſides ſtands near the church, and the eccleſiaſtics who are employed in it lodge in the ſame palace, where they receive the pilgrims of high diſtinction. The environs of this town are very agreeable, and in fine weather the high mountains of Croatia may be ſeen from hence. It is ſeated on a mountain, in E. Long. 13. 50. N. Lat. 43. 24.

LORICA, was a cuiraſs, brigantine, or coat of mail, in uſe among the Roman ſoldiers. It was generally made of leather, and is ſuppoſed to be derived from *lorum*.—The loricæ were ſet with plates of metal in various forms; ſometimes in hooks or rings like a chain, ſometimes like feathers, and ſometimes like the ſcales of ſerpents or fiſhes, to which plates of gold were often added. There were other lighter cuiraſſes conſiſting only of many folds of linen cloth, or of flax made ſtrong enough to reſiſt weapons. Such ſoldiers as were rated under 1000 drachms, inſtead of the lorica now deſcribed, wore a *pectorale*.—The Roman lorica was made like a ſhirt, and defended the wearer both before and behind, but was ſo contrived that the back part could be occaſionally ſeparated from the front. Some of the loricæ were made of cords of hemp or flax, cloſe ſet together; whence they are called *thoraces*, *bilices*, *trilices*, &c. from the number of the cords fixed one upon another; but theſe were uſed rather in hunting than in the field of battle.

LORIS, in *Zoology*. See LEMUR, MAMMALIA *Index*.

LORIMERS, one of the companies of London, that make bits for bridles, ſpurs, and ſuch like ſmall iron ware. They are mentioned in ſtatute 1 Rich. II. c. 12.—The word ſeems derived from the Latin word *lorum*, "a thong."

LORME, PHILIBERT DE, one of the moſt celebrated architects in the 16th century, was born at Lyons. Queen Catherine de Medicis gave him the ſuperintendance of buildings; and he had the direction of thoſe of the Louvre, the Thuilleries, the caſtle of St Anet, St Germains, and other edifices erected by her orders. He alſo wrote ſeveral books on architecture. He died about the year 1577.

LORNE, a diviſion of Argyllſhire in Scotland, which gives the title of marquis to the duke of Argyll. It extends above 30 miles in length from north to ſouth, and about nine at its utmoſt breadth; bounded on the eaſt by Braidalbin; on the weſt by the iſlands; on the north, by Lochaber; and is divided from Knapdale on the ſouth by Loch Etive, on the banks of which ſtands the caſtle of Bergomarn, wherein the courts of juſtice were anciently held. This diſtrict, abounding with lakes, is the moſt pleaſant and fertile part of Argyllſhire, producing plenty of oats and barley. It once belonged to the ancient family of Macdougal, ſtill reſiding on the ſpot; but devolved to the lords of Argyll in conſequence of a marriage with the heireſs, at that time a branch of the Stuart family. The chief place of note in this diſtrict is the caſtle of Dunſtaffnage, a ſeat of the Scottiſh kings previous to the conqueſt of the Picts in 843 by Kenneth II. In this place was long preſerved the famous ſtone, the palladium of North Britain; brought, ſays legend, out of Spain, where it was firſt uſed as a ſeat of juſtice by Gathelus, coeval with Moſes. It continued here as the coronation chair till the reign of Kenneth II. who removed it to Scone, in order to ſecure his reign; for, according to the inſcription,

Ni fallat fatum, Scoti quocunque locatum,
Invenient lapidem, regnare teneantur ibidem.

Some of the ancient regalia were preſerved till the preſent century, when the keeper's ſervants, during his infirm years, embezzled them for the ſilver ornaments; and left only a battleaxe, nine feet long, of beautiful workmanſhip, and ornamented with ſilver.

The caſtle is ſquare; the inſide only 87 feet; partly ruinous, partly habitable. At three of the corners are round towers; one of them projects very little. The entrance is towards the ſea at preſent by a ſtaircaſe, in old times probably by a drawbridge, which fell from a little gateway. The maſonry appears very ancient; the tops battlemented. This pile is ſeated on a rock at the mouth of Loch Etive, whoſe waters expand within to a beautiful bay, where ſhips may ſafely ride in all weather. Of this building, the founder of which is unknown, nothing remains except the outer walls, which, though roofleſs, are ſtill in good order; and within which ſome buildings have been erected, which ſerve as the reſidence of the laird. The duke of Argyll is hereditary keeper under the crown.—At a ſmall diſtance from the caſtle is a ruined chapel, once an elegant building; and at one end an encloſure, a family cemetery. Oppoſite to theſe is a high precipice, ending abrupt, and turning ſuddenly toward the ſouth-eaſt. A perſon concealed in the receſs of the rock, a little beyond the angle, ſurpriſes friends ſtationed at ſome diſtance beneath the precipice with a very remarkable echo of any word, or even ſentence, he pronounces; which reaches the laſt diſtinct and unbroken. The repetition is ſingle, but remarkably clear.

In 1307, this caſtle was poſſeſſed by Alexander Macdougal lord of Argyll, a friend to the Engliſh: but was that year reduced by Robert Bruce, when Macdougal ſued for peace with that prince, and was received into favour.

We find, about the year 1455, this to have been a reſidence of the lords of the iſles; for here James laſt earl of Douglas, after his defeat in Annandale, fled to Donald, the Regulus of the time, and prevailed on him to take arms and carry on a plundering war againſt his monarch James II.

The ſituation of this regal ſeat was calculated for pleaſure as well as ſtrength. The views of mountains, valleys, waters, and iſlands, are delightful. On the north ſide of Loch Etive ſtood the town of Beregonium, ſuppoſed to have been the capital of the Weſt Highlands. It ſeems from certain mounds, excavations, and other appearances, to have been a ſtrong fortreſs, to prevent invaſion, or to ſecure a retreat, as occaſions might require. On the bank of the ſame loch is the ſite of Ardchattan, a priory of monks of Valliſcaullium in Burgundy, founded in 1230 by Donald Maccoul, anceſtor of the Macdougals of Lorne. Here Robert Bruce, who remained maſter of this country before he got entire poſſeſſion of Scotland, held a parliament

Lorrain, Loten.

liament or council.—The country abounds in Druidical, Daniſh, and other monuments.

LORRAIN, a ſovereign ſtate of Europe, bounded on the north by Luxemburg and the archbiſhopric of Treves, on the eaſt by Alſace and the duchy of Deux Ponts, on the ſouth by Franche Comte, and on the weſt by Champagne and the duchy of Barr. It is about 100 miles in length, and 75 in breadth; and abounds in all ſorts of corn, wine, hemp, flax, rape-ſeed, game and fiſh, with which it carries on ſome trade, and in general all the neceſſaries of life. There are fine meadows and large foreſts, with mines of iron, ſilver, and copper, as alſo ſalt pits. There are a great number of rivers; of which the principal are the Maeſe or Meuſe, the Moſelle, the Scille, the Meure, and the Sarre. It is divided into three parts; the duchy of Lorrain, properly ſo called, which was heretofore a ſovereign ſtate; the duchy of Barr, which formerly belonged to the dukes of Lorrain, but afterwards came under the government of France; and the third comprehends the three biſhoprics of Metz, Toul, and Verdun, which have belonged to France ever ſince the year 1552. In 1733, the emperor of Germany being at war with France, this laſt got poſſeſſion of the duchy of Lorrain: and when there was a peace made in 1735, it was agreed, that Staniſlaus king of Poland, father-in-law to the king of France, ſhould poſſeſs theſe duchies, and that after his death they ſhould be united for ever to the crown of France. It was alſo then agreed, that Francis Stephen, duke of Lorrain, and the emperor's ſon-in-law, ſhould have the grand duchy of Tuſcany as an equivalent for Lorrain. After the death of the great duke of Tuſcany, in 1737, King Staniſlaus and the duke of Lorrain took poſſeſſion of their reſpective dominions, and the ceſſion was confirmed and guaranteed by a treaty in 1738. The trade conſiſts in corn and linen cloth. Nanci is the capital town.

Lorrain, *Robert le*, an eminent ſculptor, born at Paris in 1666. From his infancy, he made ſo rapid a progreſs in the art of deſigning, that at the age of 18 the celebrated Girardon intruſted him with the care of teaching his children and correcting his diſciples. He committed to him alſo, in conjunction with Nouliſſon, the execution of the famous tomb of Cardinal Richelieu in the Sorbonne, and his own tomb at St Landres in Paris. On his return from Rome, he finiſhed ſeveral pieces at Marſeilles, which had been left imperfect by the death of M. Puget. He was received into the academy of ſculpture in 1701. His *chef d'œuvre* is Galatea, a work univerſally admired. Lorrain afterwards made a Bacchus for the gardens at Verſailles, a Faun for thoſe of Marly; and ſeveral bronzes, among which is an Andromeda; all in an excellent taſte. This artiſt ſucceeded chiefly in heads; and more particularly in that of young girls, which he performed with incomparable delicacy and truth.

Lorrain, *Claude*. See Claude.

LOTEN, John, a good landſcape painter of the Engliſh ſchool; though a native of Switzerland. His taſte led him to ſolemn and dreary ſcenes, as land-ſtorms accompanied with ſhowers of rain, &c. and he ſeldom omitted to introduce oak trees in his proſpects: his landſcapes are generally large; and he painted with nature, truth, and force. But the effect of his compoſition had been much greater if he had been leſs cold in his colouring: for the judicious eye is not pleaſed with the darkiſh tint that predominates in it. He died in London about 1681.

Lothian.

LOTHIAN, a name given to three counties of Scotland, viz. Haddingtonſhire, Edinburghſhire, and Linlithgowſhire; otherwiſe called *Eaſt*, *Mid*, and *Weſt*, Lothians.

1. Eaſt Lothian, or Haddingtonſhire, is bounded on the north-weſt by the frith of Forth; and on the eaſt by the German ſea; on the ſouth-eaſt by Berwickſhire; and on the weſt by the county of Edinburgh. It extends about 25 miles from eaſt to weſt, and where broadeſt, nearly 15 from north to ſouth. The coaſt, advancing northward into the frith, forms an irregular curve.—This is one of the moſt fruitful counties in Scotland, producing great quantities of wheat and all ſorts of grain, well watered, and plentifully ſupplied with fiſh, fowl, fuel, and all the neceſſaries of life. It abounds with towns, villages, and farms, interſperſed with a great number of agreeable houſes belonging to perſons of rank and fortune. For cultivation, populouſneſs, and fertility, this ſhire may vie with any tract of land in the iſland of Great Britain. Beſide farming, which is ſucceſsfully carried on, the people towards the ſea-coaſt employ themſelves in the fiſhery, ſalt-making, and in foreign trade; and ſome of the more inland inhabitants engage in the linen and woollen manufactures. Limeſtone and coal are found in moſt parts of the county, and great numbers of ſheep are fed on the hills of Lammermuir.

2. Edinburghſhire, or Mid Lothian, is about 35 miles long, but varies in its breadth in different places from five to 16 miles. It is bounded on the eaſt by Haddingtonſhire; on the weſt by the ſhire of Linlithgow; on the ſouth, by Tweeddale or Peebleſſhire; and on the north, by part of Weſt Lothian and the frith of Forth. The aſpect of the country is in general level and pleaſant, interſperſed with a few hills, that help to exhibit agreeable proſpects. It is well watered with rivers, and ſhaded with woods. It produces plenty of coal, limeſtone, a ſoft black marble, and ſome copper ore. The ſoil, of itſelf fertile, is finely cultivated, and yields as plentiful harveſts of excellent wheat as are found in any part of Great Britain. The whole ſhire is interſperſed with noble houſes and plantations belonging to noblemen and gentlemen of fortune. The farmers, in general, are ſkilful and wealthy. The country is well inhabited, and preſents us with a good number of towns and populous villages. Along the ſea coaſt the common people ſubſiſt by fiſhing, and traffic in coals and ſalt, and ſome few carry on a ſmuggling commerce. Thoſe in the inland are employed in farming, and ſome branches of the weaving manufacture. Edinburgh is a county within itſelf.

3. The ſhire of Linlithgow, or Weſt Lothian, is bounded on the north by the frith of Forth. The ſmall river Almond divides it from Edinburghſhire on the eaſt. On the ſouth-weſt it joins the county of Lanark; and on the weſt, it is parted from Stirlingſhire by Avon, a ſmall river. Its form, though irregular, approaches to a parallelogram. It meaſures from north-eaſt to ſouth-weſt, nearly 20 miles. Its breadth, except on the ſhore of the frith, does not exceed 12.—The coun-

try is pleaſant and fertile, abounding with corn and paſturage. Here is found plenty of coal, limeſtone, and lead ore; nay, in the reign of James VI. it produced a rich mine of ſilver.

LOTION is, ſtrictly ſpeaking, ſuch waſhing as concerns beautifying the ſkin, by cleanſing it of thoſe deformities which a diſtempered blood throws upon it. Medicines of this kind, however, are for the moſt part inſignificant, and ſometimes very dangerous; the only proper method of treating theſe diſorders is, by adminiſtering ſuch medicines as tend to correct the morbid ſtate of the conſtitution from whence they ariſe.

LOTION, in *Pharmacy*, denotes a preparation of medicines, by waſhing them in ſome liquid, either made very light, ſo as to take away only the dregs; or ſharp, ſo as to penetrate them, in order to clear them of ſome ſalt, or corroſive ſpirit, as is done to antimony, precipitates, magiſteries, &c. or intended to take away ſome foulneſs or ill quality, or to communicate ſome good one.

LOTOPHAGI, in *Ancient Geography*, a people of the Regio Syrtica (ſo called from their living on the lotus); inhabiting between the two Syrtes from the Cinyphus to the Triton. The lotus was ſaid to be a food ſo luſcious, as to make ſtrangers forget their native country. A ſweet wine was expreſſed from it, which did not keep above ten days, (Pliny).

LOTOPHAGI of Homer. See MENINX.

LOTTERY, a kind of public game at hazard, frequent in Britain, France, and Holland, in order to raiſe money for the ſervice of the ſtate; being appointed with us by the authority of parliament, and managed by commiſſioners appointed by the lords of the treaſury for that purpoſe. It conſiſts of ſeveral numbers of blanks and prizes, which are drawn out of wheels, one of which contains the numbers, and the other the correſponding blanks or prizes.

The Romans invented lotteries to enliven their Saturnalia. This feſtival began by the diſtribution of tickets which gained ſome prize. Auguſtus made lotteries which conſiſted of things of little value; but Nero eſtabliſhed ſome for the people, in which 1000 tickets were diſtributed daily, and ſeveral of thoſe who were favoured by Fortune got rich by them. Heliogabalus invented ſome very ſingular: the prizes were either of great value or of none at all; one gained a prize of ſix ſlaves, and another of ſix flies; ſome got valuable vaſes, and others vaſes of common earth. A lottery of this kind exhibited an excellent picture of the inequality with which Fortune diſtributes her favours.

The firſt Engliſh lottery we find mentioned in hiſtory was drawn A. D. 1569. It conſiſted of 40,000 lots, at 10s. each lot: the prizes were plate; and the profits were to go towards repairing the havens of this kingdom. It was drawn at the weſt door of St Paul's cathedral. The drawing began on the 11th of January 1569, and continued inceſſantly, *day and night*, till the 6th of May following; as Maitland, from Stowe, informs us in his hiſtory, vol. i. p. 257. There were then only *three* lottery offices in London. The propoſals for this lottery were publiſhed in the years 1567 and 1568. It was at firſt intended to have been drawn at the houſe of Mr Dericke, her majeſty's ſervant, i. e. her jeweller, but was afterwards drawn as above mentioned.

Dr Rawlinſon ſhowed the Antiquarian Society, 1748, "A propoſal for a very rich lottery, general without any blankes, contayning a great number of good prizes, as well of redy money as of plate and certain ſorts of merchandizes, having been valued and priſed by the commandment of the queene's moſt excellent majeſtie's order, to the entent that ſuch commodities as may chance to ariſe thereof after the charges borne may be converted towards the reparations of the havens and ſtrength of the realme, and towards ſuch other public good workes. The number of lotts ſhall be foure hundred thouſand, and no more; and every lott ſhall be the ſum of tenne ſhillings ſterling, and no more. To be filled by the feaſt of St Bartholomew. The ſhew of priſes are to be ſeen in Cheapſide, at the ſign of the Queene's Armes, the houſe of Mr Dericke, goldſmith, ſervant to the queene. Some other orders about it in 1567-8. Printed by Hen. Bynneyman."

"In the year 1612, King James, in ſpecial favour for the preſent plantation of Engliſh colonies in Virginia, granted a lottery, to be held at the weſt end of St Paul's; whereof one Thomas Sharplys, a taylor of London, had the chief prize, which was 4000 crowns in fair plate." Baker's Chronicle.

In the reign of Queen Anne, it was thought neceſſary to ſuppreſs lotteries, as nuiſances to the public. Since that time, however, they have been licenſed by an act of parliament, under various regulations. The act paſſed in 1778 reſtrains any perſon from keeping an office for the ſale of tickets, ſhares, or chances, or for buying, ſelling, enſuring, or regiſtering, without a licenſe; for which licenſe each office-keeper muſt pay 50l. to continue in force for one year, and the produce to be applied towards defraying the expences of the lottery. And no perſon is allowed to ſell any ſhare or chance leſs than a ſixteenth, on the penalty of 50l. All tickets divided into ſhares or chances are to be depoſited in an office, to be eſtabliſhed in London by the commiſſioners of the treaſury, who are to appoint a perſon to conduct the buſineſs thereof; and all ſhares are to be ſtamped by the ſaid officer, who is to give a receipt for every ticket depoſited with him. The numbers of all tickets ſo depoſited are to be entered in a book, with the names of the owners, and the number of ſhares into which they are divided; and twopence for each ſhare is to be paid to the officer on depoſiting ſuch tickets, who is therewith to pay all expences incident to the office. All tickets depoſited in the office are to remain there three days after the drawing. And any perſon keeping an office, or ſelling ſhares, or who ſhall publiſh any ſcheme for receiving moneys in conſideration of any intereſt to be granted in any ticket in the ſaid lottery, &c. without being in poſſeſſion of ſuch ticket, ſhall forfeit 500l. and ſuffer three months impriſonment. And no buſineſs is to be tranſacted at any of the offices after eight in the evening, except on the evening of the Saturday preceding the drawing. No perſon is to keep any office for the ſale of tickets, &c. in Oxford or Cambridge, on penalty of 20l. Before this regulating ſtatute took place, there were upwards of 400 lottery offices in and about London only; but the whole number afterwards, for all Britain, as appeared by the liſt publiſhed by authority, amounted to no more than 51.

LOTUS, or BIRD'S-FOOT TREFOIL; a genus of plants

plants belonging to the diadelphia clafs; and in the natural method ranking under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

Lotus of Homer. See DIOSPYROS, }
Egyptian Lotus. See NYMPHÆA, } BOTANY
Libyan Lotus. See RHAMNUS, } *Index*.
LOVAGE. See LIGUSTICUM, }

LOVE, in a large fenfe of the word, denotes all thofe affections of the pleafing kind which objects and incidents raife in us; thus we are faid to *love* not only intelligent agents of morally good difpofitions, but alfo fenfual pleafures, riches, and honours. But

LOVE, in its ufual and more appropriate fignification, may be defined, "that affection which, being compounded of animal defire, efteem, and benevolence, becomes the bond of attachment and union between individuals of the different fexes; and makes them feel in the fociety of each other a fpecies of happinefs which they experience no where elfe." We call it an *affection* rather than a *paffion*, becaufe it involves a defire of the happinefs of its object: And that its conftituent parts are thofe which have been juft enumerated, we fhall firft endeavour to prove, and then proceed to trace its rife and progrefs from a felfifh appetite to a generous fentiment.

Animal defire is the actual energy of the fenfual appetite: and that it is an effential part of the complex affection, which is properly called *love*, is apparent from this confideration, that though a man may have fentiments of efteem and benevolence towards women who are both old and ugly, he never fuppofes himfelf to be in love of any woman, to whom he feels not the fenfual appetite to have a ftronger tendency than to other individuals of her fex. On the other hand, that animal defire *alone* cannot be called the affection of love is evident; becaufe he who gratifies fuch a defire without efteeming its object, and wifhing to communicate at the fame time that he receives enjoyment, loves not the woman, but himfelf. Mere animal defire has nothing in view but the fpecies and the fex of its object; and before it make a felection, it muft be combined with fentiments very different from itfelf. The firft fentiment with which it is combined, and by which a man is induced to prefer one woman to another, feems to be that by which we are delighted with gracefulnefs of perfon, regularity of features, and beauty of complexion. It is not indeed to be denied that there is fomething irrefiftible in female beauty. The moft fevere will not pretend that they do not feel an immediate prepoffeffion in favour of a handfome woman: but this prepoffeffion, even when combined with animal defire, does not conftitute the whole of that affection which is called *love*. Savages feel the influence of the fenfual appetite, and it is extremely probable that they have fome ideas of beauty; but among favages the affection of love is feldom felt. Even among the lower orders in civil fociety it feems to be a very grofs paffion, and to have in it more of the felfifhnefs of appetite than of the generofity of efteem. To thefe obfervations many exceptions will no doubt be found (A): but we fpeak of favages in general, and of the great body of the labouring poor, who in the choice of their mates do not ftudy—who indeed are incapable of ftudying, that rectitude of mind, and thofe delicacies of fentiment, without which neither man nor woman can deferve to be efteemed.

In the favage ftate, and even in the firft ftages of refinement, the bond of union between the fexes feems to confift of nothing more than mere animal defire and inftinctive tendernefs for their infant progeny. The former impels them to unite for the propagation of the fpecies; and the latter preferves the union, till the children, who are the fruit of it, be able to provide for their own fubfiftence. That in fuch unions, whether cafual or permanent, there is no mutual efteem and benevolence, is apparent from the ftate of fubjection in which women are held in rude and uncultivated nations, as well as from the manner in which marriages are in fuch nations contracted.

Sweetnefs of temper, a capital article with us in the female character, difplays itfelf externally in mild looks and gentle manners, and is the firft and perhaps the moft powerful inducement to love in a cultivated mind. "But fuch graces (fays an ingenious writer *) are fcarce difcernible in a female favage; and even in the moft polifhed woman would not be perceived by a male favage. Among favages, ftrength and boldnefs are the only valuable qualities. In thefe, females are miferably deficient; for which reafon they are contemned by the males as beings of an inferior order. The North American tribes glory in idlenefs: the drudgery of labour degrades a *man* in their opinion, and is proper for *women* only. To join young perfons in marriage is accordingly the bufinefs of the parents; and it would be unpardonable *meannefs* in the bridegroom to fhow any *fondnefs* for the bride. In Guiana a woman never eats with her *hufband*, but after every meal attends him with water for wafhing; and in the Caribbee iflands fhe is not even permitted to eat in the *prefence* of her hufband. Dampier obferves in general, that among all the wild nations with which he was acquainted, the women carry the burdens, while the men walk before and carry nothing but their arms; and that women even of the higheft rank are not better treated. In Siberia, and even in Ruffia, the capital excepted, men till very lately treated their wives in every refpect like flaves. It might indeed be thought, that animal defire, were there nothing elfe, fhould have raifed women to fome degree of eftimation among men; but male favages, utter ftrangers to decency and refinement, gratify animal defire with as little ceremony as they do hunger or thirft.

* *Sketches of the Hiftory of Man.*

"Hence it was that in the early ages of fociety a man *purchafed* a woman to be his wife, as one purchafes an ox or a fheep to be food; and valued her only as fhe contributed to his fenfual gratification. Inftances innumerable might be collected from every nation of which we are acquainted with the early hiftory; but we

(A) Such as the negroes whofe ftory is fo pathetically told by Addifon in N° 215 of the Spectator; the two lovers who were killed by lightning at Staunton-Harcourt, Auguft 9. 1718, (fee *Pope's Letters*); and many others which will occur to every reader.

we ſhall content ourſelves with mentioning a few. Abraham bought Rebekah and gave her to his ſon Iſaac for a wife *. Jacob having nothing elſe to give, ſerved Laban 14 years for two wives †. To David, demanding Saul's daughter in marriage, it was ſaid, 'The king deſireth not any dowry, but an hundred foreſkins of the Philiſtines ‡.' In the Iliad Agamemnon offers his daughter to Achilles for a wife; and ſays that he would not demand for her any *price* §. By the laws of Ethelbert king of England, a man who committed adultery with his neighbour's wife was obliged to pay the huſband a fine, and to *buy him another wife* ‖." But it is needleſs to multiply inſtances; the practice has prevailed univerſally among nations emerging from the ſavage ſtate, or in the rudeſt ſtage of ſociety: and wherever it prevailed, men could not poſſibly have for the fair ſex any of that tender regard and eſteem which conſtitute ſo eſſential a part of the complex affection of love.

* Gen. xxiv.
† Gen. xxix.
‡ 1 Sam. xviii. 28.
§ Lib. ix.
‖ Sect. 32.

Accordingly we find the magnanimous Achilles an abſolute ſtranger to that generous affection, though his heart was ſuſceptible of the warmeſt and pureſt friendſhip. His attachment to Patroclus was ſo heroically diſintereſted, that he willingly ſacrificed his own life to revenge the death of his friend; but when Agamemnon threatened to rob him of his favourite female captive, though he felt the inſult offered to his *pride*, he never ſpoke of the *woman* but as a *ſlave* whom he was concerned to preſerve in point of *honour*, and as a teſtimony of his *glory*. Hence it is that we never hear him mention her but as his *ſpoil*, the *reward of war*, or the *gift* which the Grecians gave him.

" And dar'ſt thou threat to ſnatch my *prize* away,
" Due to the deeds of many a dreadful day?
" A *prize* as *ſmall*, O tyrant! match'd with thine,
" As thy own actions if compar'd with mine.
" Thine in each conqueſt is the *wealthy prey*,
" Tho' mine the ſweat and danger of the day.
" Some *trivial preſent* to my ſhips I bear,
" Or barren praiſes pay the wounds of war."

And again, after upbraiding the general with his tyranny and want of regard to merit, he adds, with the greateſt indifference as to the charms of the *woman*,

" Seize on Briſeïs, whom the Grecians doom'd
" My *prize of war*, yet tamely ſee *reſum'd*;
" And ſeize ſecure; no more Achilles draws
" His conquering ſword in any woman's cauſe.
" The gods command me to forgive the paſt;
" But let this firſt *invaſion* be the laſt:
" For know, thy blood, when *next* thou dar'ſt *invade*,
" Shall ſtream in vengeance on my reeking blade."

Pope has made the language of this rough warrior leſs inconſiſtent with the peculiar reſentment natural to an injured lover than it is in the original (B); but from the laſt quoted paſſage, even as tranſlated by him, it is apparent that Achilles would have been equally hurt had Agamemnon threatened to deprive him of any other part of his plunder. Accordingly he yields up Briſeis, not in grief for a miſtreſs whom he loſes, but in ſullenneſs for an injury that is done him. Nor let it be imagined, that this coldneſs proceeded from the pride of the hero, which would not permit him to acknowledge his love of a captive. With the generous affection of love captives and princeſſes were equally incapable of inſpiring him. He repeatedly affirmed indeed that he delighted in his fair Lyrneſſian ſlave, but it was only as an inſtrument of ſenſual gratification; for as to every thing elſe in a woman, he was ſo totally indifferent, that he declared he would not, when he ſhould be diſpoſed to marry, give himſelf the trouble to make a *choice*, but leave the whole matter to his father.

" If heav'n reſtore me to my realms with life,
" The rev'rend Peleus ſhall elect my wife."

Even Agamemnon, of whom Pope and Madame Dacier think more favourably as a lover, ſpeaks the very ſame language when mentioning his favourite captive Chryſeis. In his furious debate with Achilles he calls her indeed—

" A maid, unmatch'd in manners as in face,
" Skill'd in each art, and crown'd with ev'ry grace."

And adds,

" Not half ſo dear were Clytemneſtra's charms,
" When firſt her blooming beauties bleſt my arms."

But this was ſaid merely to enhance the value of the *prize*, which for the public good he was about to reſign; for that ſhe was dear to him only as miniſtering to his pleaſure, is paſt diſpute from the language which he had previouſly held with her father, as well as from his requiring grateful Greece to pay a juſt *equivalent*, and to repair his *private loſs*. A man who really *lovea* would have thought nothing an *equivalent* for the object of his love; much leſs would he have inſinuated to her father

(B) The original paſſages are:

Και δη μοι γερας αυτος αφαιρησεσθαι απειλεις,
Ὡ επι πολλ᾽ εμογησα, δοσαν δε μοι υἷες Αχαιων.
Ου μεν σοι ποτε ισον εχω γερας, οπποτ᾽ Αχαιοι
Τρωων εκπερσωσ᾽ ευναιομενον πτολιεθρον.
Αλλα το μεν πλειον πολυαικος πολεμοιο
Χειρες εμαι διεπουσ᾽· αταρ ην ποτε δασμος ἱκηται,
Σοι το γερας πολυ μειζον, εγω δ᾽ ολιγον τε φιλον τε
Ερχομ᾽ ηχων επι νηας, επην κεκαμω πολεμιζων.

Iliad, lib. i.

And, Αλλο δε τοι ερεω, συ δ᾽ ενι φρεσι βαλλεο σησι·
Χερσι μεν ουτι εγωγε μαχησομαι, εινεκα κουρης,
Ουτε σοι, ουτε τω αλλω, επει μ᾽ αφελεσθε γε δοντες.
Των δ᾽ αλλων, α μοι εστι θοη παρα νηι μελαινη,
Των ουκ αν τι φεροις ανελων, αεκοντος εμειο·
Ει δ᾽ αγε μην, πειρησαι, ινα γνωωσι και οἵδε.
Αιψα τοι αἱμα κελαινον ερωησει περι δουρι.

In this latter paſſage the hero ſays expreſsly, "I will not fight with you or with any other man for the ſake of a *girl*; but you ſhall not rob me of any other part of my *property*:" which is ſurely the language of a man to whoſe heart love muſt have been an utter ſtranger.

Love.

father a poſſibility of his diſmiſſing from his embrace a woman whom he eſteemed, when time ſhould have robbed her of every youthful grace.

Since, then, it is ſo apparent, that in the heroic age of Greece even princes and kings were ſtrangers to the generous affection of love, it needs not occaſion much ſurpriſe that the ſame affection has very little influence upon mankind in the loweſt ranks of the moſt poliſhed ſocieties of modern Europe. That this is actually the caſe, that among the generality of uneducated men and women there is no other bond of attachment than the ſenſual appetite, every year furniſhes multiplied proofs. We daily ſee youths, rejected by their miſtreſſes, paying their addreſſes without delay to girls who, in looks, temper, and diſpoſition, are diametrically oppoſite to thoſe whom ſo lately they pretended to love: We daily ſee maidens, ſlighted by their lovers, receiving the addreſſes of men, who, in nothing but their ſex, reſemble thoſe to whom a week before they wiſhed to be married: and we believe it is not very uncommon to find a girl entertaining ſeveral lovers together, that if one or more of them ſhould prove falſe, ſhe may ſtill have a chance not to be totally deſerted. Did eſteem and benevolence, placed on manners and character, conſtitute any part of vulgar love, theſe people would act very differently; for they would find it impoſſible to change their lovers and their miſtreſſes with the ſame eaſe that they change their clothes.

To this account of love, as it appears in ſavage nations, ſome one may perhaps oppoſe the paintings of the ſofter paſſion in the poems of Oſſian. That bard deſcribes the female character as commanding reſpect and eſteem, and the Caledonian heroes as cheriſhing for their miſtreſſes a flame ſo pure and elevated as never was ſurpaſſed, and has ſeldom been equalled, in thoſe ages which we commonly call moſt enlightened. This is indeed true: and it is one of the many reaſons which have induced Johnſon and others to pronounce the whole a modern fiction. Into that debate we do not enter. We may admit the authenticity of the poems, without acknowledging that they furniſh any exception to our general theory. They furniſh indeed in the manners which they deſcribe a wonderful anomaly in the general hiſtory of man. All other nations of which we read were in the hunter ſtate ſavage and cruel. The Caledonians, as exhibited by Oſſian, are gentle and magnanimous. The heroes of Homer fought for plunder, and felt no clemency for a vanquiſhed foe. The heroes of Oſſian fought for fame; and when their enemies were ſubdued, they took them to their boſoms. The firſt of Greeks committed a mean inſult on the dead body of the firſt of Trojans. Among the Caledonians inſults offered to the dead, as well as cruelty to the living, were condemned as infamous. The heroes of Oſſian appear in no inſtance as ſavages. How they came to be poliſhed and refined before they were acquainted with agriculture and the moſt uſeful arts of life, it is not our buſineſs to inquire; but ſince they unqueſtionably were ſo, their treatment of the female ſex, inſtead of oppoſing, confirms our theory; for we never conceived rich clothes, ſuperb houſes, highly-dreſſed food, or even the knowledge of foreign tongues, to be neceſſary to the acquiſition of a generous ſentiment. Luxury indeed appears to be as inimical to love as barbariſm: and we believe, that in modern nations, the tender and exalted affection which deſerves that name is as little known among the higheſt orders of life as among the loweſt. Perhaps the Caledonian ladies of Oſſian reſembled in their manners the German ladies of Tacitus, who accompanied their huſbands to the chaſe, fought by their ſides in battle, and partook with them of every danger. If ſo, they could not fail to be reſpected by a race of heroes among whom courage took place of all other virtues: and this ſingle circumſtance, from whatever cauſe it might proceed, will ſufficiently account for the eſtimation of the female character among the ancient Germans and Caledonians, ſo different from that in which it has been held in almoſt every other barbarous nation.

But if among ſavages and the vulgar, love be unknown, it cannot poſſibly be an inſtinctive affection: and therefore it may be aſked, How it gets poſſeſſion of the human heart; and by what means we can judge whether in any particular inſtance it be real or imaginary? Theſe queſtions are of importance, and deſerve to be fully anſwered; though many circumſtances conſpire to render it no eaſy taſk to give to them ſuch anſwers as ſhall be perfectly ſatisfactory. Love can ſubſiſt only between *individuals* of the different ſexes. A man can hardly *love two women* at the ſame time; and we believe that a woman is ſtill *leſs* capable of *loving at once more than one man*. Love, therefore, has a natural tendency to make men and women pair, or, in other words, it is the ſource of marriage: but in poliſhed ſociety, where alone this affection has any place, ſo many things beſides mutual attachment are neceſſary to make the married life comfortable, that we rarely ſee young perſons uniting from the impulſe of love, and have therefore but few opportunities of tracing the riſe, progreſs, and conſequences of the affection. We ſhall, however, throw together ſuch reflections as have occurred to us on the ſubject, not without indulging a hope, that they may be uſeful to the younger part of our readers when forming the moſt important connexion in life.

We have ſaid, that the perception of beauty, combined with animal deſire, is the firſt inducement which a man can have to prefer one woman to another. It may be added, that elegance of figure, a placid maſculine countenance, with a perſon which indicates ſtrength and agility, are the qualities which firſt tend to attach any woman to a particular man. Beauty has been defined *, "That particular form, which is the moſt common of all particular forms to be met with in the ſame ſpecies of beings." Let us apply this definition to our own ſpecies, and try, by means of it, to aſcertain what conſtitutes the beauty of the human face. It is evident, that of countenances we find a number almoſt infinite of different forms, of which forms one only conſtitutes beauty, whilſt the reſt, however numerous, conſtitute what is *not beauty*, but *deformity* or *uglineſs*. To an attentive obſerver, however, it is evident, that of the numerous particular forms of *uglineſs*, there is not one which includes ſo many faces as are formed after that particular caſt which conſtitutes *beauty*. Every particular ſpecies of the animal as well as of the vegetable creation, may be ſaid to have a fixed or determinate form, to which, as to a centre, nature is continually inclining. Or it may be

* By Pere Buffier in his *Firſt Truths*, and Sir Joſhua Reynolds in the *Idler*.

Love.

be compared to pendulums vibrating in different directions over one central point; and as they *all* crofs the *centre*, though only *one* paffes through any *other point;* fo it will be found that *perfect beauty* is oftener produced by nature than deformity: we do not mean than deformity in *general*, but than any *one kind* and *degree* of deformity. To inftance in a particular part of a human feature: the line which forms the ridge of the nofe is deemed beautiful when it is *ftraight;* but this is likewife the *central* form, which is oftener found than any one *particular degree* of *concave*, *convex*, or any *other* irregular form that fhall be propofed. As we are then more accuftomed to beauty than deformity, we may conclude *that* to be the reafon why we approve and admire it, juft as we approve and admire fashions of drefs for no other reafon than that we are ufed to them. The fame thing may be faid of colour as of form: it is cuftom alone which determines our preference of the colour of the *Europeans* to that of the *Ethiopians*, and which makes them prefer their own colour to ours; fo that though habit and cuftom cannot be the *caufe* of beauty (fee BEAUTY), they are certainly the caufe of our liking it.

That we *do like it* cannot be denied. Every one is confcious of a pleafing emotion when contemplating beauty either in man or woman; and when that pleafure is combined with the gratification of the fenfual appetite, it is obvious that the fum of enjoyment muft be greatly increafed. The perception of beauty, therefore, neceffarily directs the energy of the fenfual appetite to a *particular* object; but ftill this combination is a mere felfifh feeling, which regards its object only as the *beft* of many *fimilar* inftruments of pleafure. Before it can deferve the name of *love*, it muft be combined with efteem, which is never beftowed but upon moral character and internal worth; for let a woman be ever fo beautiful, and of courfe ever fo defirable as an inftrument of fenfual gratification, if fhe be not poffeffed of the virtues and difpofitions which are peculiar to her fex, fhe will infpire no man with a generous affection. With regard to the outlines, indeed, whether of internal difpofition or of external form, men and women are the fame; but nature, intending them for mates, has given them difpofitions, which though concordant, are, however, different, fo as to produce together delicious harmony. "The man, more robuft, is fitted for fevere labour, and for field exercifes; the woman, more delicate, is fitted for fedentary occupations, and particularly for nurfing children. The man, bold and vigorous, is qualified for being a protector *; the woman, delicate and timid, requires protection. Hence it is, that a man never admires a woman for poffeffing bodily ftrength or perfonal courage; and women always defpife men who are totally deftitute of thefe qualities. The man, as a protector, is directed by nature to govern; the woman, confcious of inferiority, is difpofed to obey. Their intellectual powers correfpond to the deftination of nature. Men have penetration and folid judgement to fit them for governing; women have fufficient underftanding to make a decent figure under good government: a greater proportion would excite dangerous rivalfhip between the fexes, which nature has avoided by giving them different talents. Women have more imagination and fenfibility than men, which make all their enjoyments more exquifite; at the fame time that they are better qualified to communicate enjoyment. Add another capital difference of difpofition: the gentle and infinuating manners of the female fex tend to foften the roughnefs of the other fex; and wherever women are indulged with any freedom, they polifh fooner than men.

* *Sketches of Man.*

"Thefe are not the only particulars that diftinguifh the fexes. With refpect to the ultimate end of love, it is the privilege of the male, as fuperior and protector, to make a choice: the female, preferred, has no privilege but barely to confent or to refufe. Whether this diftinction be the immediate refult of the originally different difpofitions of the fexes, or only the effect of affociations inevitably formed, may be queftioned; but among all nations it is the practice for men to court, and for women to be courted: and were the moft beautiful woman on earth to invert this practice, fhe would forfeit the efteem, however by her external grace fhe might excite the defire, of the man whom fhe addreffed. The great moral virtues which may be comprehended under the general term *integrity*, are all abfolutely neceffary to make either men or women eftimable; but to procure efteem to the female character, the modefty peculiar to their fex is a very effential circumftance. Nature hath provided them with it as a defence againft the artful folicitations of the other fex before marriage, and alfo as a fupport of conjugal fidelity.

A woman, therefore, whofe difpofitions are gentle, delicate, and rather timid than bold, who is poffeffed of a large fhare of fenfibility and modefty, and whofe manners are foft and infinuating, muft, upon moral principles (fee MORAL PHILOSOPHY), command the efteem and benevolence of every individual of the other fex who is poffeffed of found underftanding; but if her perfon be deformed, or not fuch as to excite fome degree of animal defire, fhe will attract no man's love. In like manner, a man whofe moral character is good, whofe underftanding is acute, and whofe converfation is inftructive, muft command the efteem of every fenfible and virtuous woman; but if his figure be difagreeable, his manner unpolifhed, his habits flovenly, and above all, if he be deficient in perfonal courage, he will hardly excite defire in the female breaft. It is only when the qualities which command efteem are, in the fame perfon, united with thofe which excite defire, that the individual fo accomplifhed can be an object of love to one of the other fex; but when thefe qualities are thus united, each of them increafes the other in the imagination of the lover. The beauty of his miftrefs gives her, in his apprehenfion, a greater fhare of gentlenefs, modefty, and every thing which adorns the female character, than perhaps fhe really poffeffes; whilft his perfuafion of her internal worth makes him, on the other hand, apprehend her beauty to be abfolutely unrivalled.

To this theory an objection readily offers itfelf, which it is incumbent upon us to obviate. Men and women fometimes fall in love at firft fight, and very often before they have opportunities of forming a juft eftimate of each other's moral character: How is this circumftance to be reconciled with the progreffive generation of love? We anfwer, By an affociation of ideas which is formed upon principles of phyfiognomy.

Love.

my. Every paſſion and habitual diſpoſition of mind gives a particular caſt to the countenance, and is apt to diſcover itſelf in ſome feature of the face. This we learn by experience; and in time, without any effort of our own, the idea of each particular caſt of countenance comes to be ſo cloſely aſſociated in our minds with the internal diſpoſition which it indicates, that the one can never afterwards be preſented to our view without inſtantly ſuggeſting the other to the imagination. (See METAPHYSICS and PHYSIOGNOMY). Hence it is that every man, who has been accuſtomed to make obſervations, naturally forms to himſelf, from the features and lineaments of a ſtranger's face, ſome opinion of his character and fortune. We are no ſooner preſented to a perſon for the firſt time, than we are immediately impreſſed with the idea of a proud, a reſerved, an affable, or a good-natured man; and upon our going into a company of abſolute ſtrangers, our benevolence or averſion, our awe or contempt, riſes inſtantly towards particular perſons, before we have heard them ſpeak a word, or know ſo much as their names or deſignations. The ſame thing happens when we are preſented to the fair ſex. If a woman, ſeen for the firſt time, have that particular caſt of countenance, and that expreſſion of features, to which we have aſſociated notions of *gentleneſs*, *modeſty*, and other female virtues, ſhe inſtantly commands our *eſteem;* and if ſhe have likewiſe ſo much *beauty* as to make her an object of particular *deſire*, eſteem and deſire become ſuddenly combined; and that combination conſtitutes the affection of love. Such, too, is the nature of all mental aſſociations, that each part of which they are compoſed adds ſtrength and vividneſs to the other parts; ſo that, in the preſent inſtance, deſire makes us imagine virtues in the woman which her countenance perhaps does not indicate; and the virtues which are there actually viſible, make us apprehend her beauty as more perfect than it is.

The affection thus generated is more or leſs pure, and will be more or leſs permanent, according as the one or the other part of which it is compounded predominates. "Where deſire of poſſeſſion * prevails over our eſteem of the perſon and merits of the deſirable object, love loſes its benevolent character: the appetite for gratification becomes ungovernable, and tends violently to its end, regardleſs of the miſery that muſt follow. In that ſtate love is no longer a ſweet agreeable affection; it becomes a ſelfiſh, painful paſſion, which, like hunger and thirſt, produceth no happineſs but in the inſtant of fruition; and when fruition is over, diſguſt and averſion generally ſucceed to deſire. On the other hand, where eſteem, founded on a virtuous character and gentle manners, prevails over animal deſire, the lover would not for the world gratify his appetite at the expence of his miſtreſs's honour or peace of mind. He wiſhes, indeed, for enjoyment; and to him enjoyment is more exquiſite than to the mere ſenſual lover, becauſe it unites ſentiment with the gratification of ſenſe; at the ſame time that, ſo far from being ſucceeded by diſguſt or averſion, it increaſes his benevolence to the woman, whoſe character and manners he eſteems, and who has contributed ſo much to his pleaſure. Benevolence to an individual, having a general end, admits of acts without number, and is ſeldom fully accompliſhed. Hence mutual love, which is compoſed chiefly of eſteem and benevolence, can hardly be of a ſhorter duration than its objects. Frequent enjoyment endears ſuch lovers to each other, and makes conſtancy a pleaſure; and when the days of ſenſual enjoyment are over, eſteem and benevolence will remain in the mind, making ſweet, even in old age, the ſociety of that pair, in whom are collected the affections of huſband, wife, lover, friend, the tendereſt affections of human nature."

* *Sketches of Man.*

From the whole of this inveſtigation, we think it appears, that the affection between the ſexes which deſerves the name of *love*, is inſeparably connected with virtue and delicacy; that a man of looſe morals cannot be a faithful or a generous lover; that in the breaſt of him who has ranged from woman to woman for the mere gratification of his ſenſual appetite, deſire muſt have effaced all eſteem for the female character; and that, therefore, the maxim too generally received, "that a reformed rake makes the beſt huſband," has very ſeldom a *chance* to be true. We think it may likewiſe be inferred, that thouſands fancy themſelves in love who know not what love is, or how it is generated in the human breaſt: and therefore we beg leave to adviſe ſuch of our readers as may imagine themſelves to be in that ſtate, to examine their own minds, with a view to diſcover, whether, if the objects of their love were old or ugly, they would ſtill eſteem them for the virtues of their character, and the propriety of their manners. This is a queſtion which deſerves to be well weighed by the young and the amorous, who, in forming the matrimonial connexion, are too often blindly impelled by the mere animal deſire inflamed by beauty. "It may indeed happen †, after the pleaſure of gratifying that deſire is gone (and if not refined by eſteem and benevolence, go it muſt with a ſwift pace), that a new bond of attachment may be formed upon more dignified and more laſting principles; but this is a dangerous experiment. Even ſuppoſing good ſenſe, good temper, and internal worth of every ſort, yet a new attachment upon ſuch qualifications is rarely formed; becauſe it *commonly* or rather *always*, happens, that ſuch qualifications, the only ſolid foundation of an indiſſoluble connexion, if they did not originally make eſteem predominate over animal deſire, are afterwards rendered altogether inviſible by ſatiety of enjoyment creating diſguſt."

† *Elements of Criticiſm.*

LOVE, in *Medicine*. The ſymptoms produced by this paſſion as a diſeaſe, according to medical writers, are as follow: The eyelids often twinkle; the eyes are hollow, and yet appear as if full with pleaſure: the pulſe is not peculiar to the paſſion, but the ſame with that which attends ſolicitude and care. When the object of this affection is thought of, particularly if the idea is ſudden, the ſpirits are confuſed, the pulſe changes, and its force and time are very variable: in ſome inſtances, the perſon is ſad and watchful; in others, the perſon, not being conſcious of his ſtate, pines away, is ſlothful, and regardleſs of food; though the wiſer, when they find themſelves in love, ſeek pleaſant company and active entertainments. As the force of love prevails, ſighs grow deeper; a tremor affects the heart and pulſe; the countenance is alternately pale and red; the voice is ſuppreſſed in the fauces; the eyes grow dim; cold ſweats break out; ſleep abſents itſelf, at leaſt until the morning; the ſecretions become

become difturbed; and a lofs of appetite, a hectic fever, melancholy, or perhaps madnefs, if not death, conftitutes the fad cataftrophe. On this fubject the curious may confult Ægineta, lib. iii. cap. 17. Oribat. Synop. lib. viii. cap. 9. or a treatife profeffedly written on love, as it is a diftemper, by James Ferrard, Oxford, printed 1640.

The manners of the Greeks and Romans were fimilar to each other in the affairs of love. They generally made a difcovery of their paffion by writing upon trees, walls, doors, &c. the name of their beloved. They ufually decked the door of their dulcinea with flowers and garlands, made libations of wine before their houfes, fprinkling the pofts with the fame liquor, as if the object of their affection was a real goddefs. For a man's garland to be untied, and for a woman to compofe a garland, were held to be indubitable indications of their love.

When their love was without fuccefs, they ufed feveral arts to excite affection in the object of their defire. They had recourfe to enchantreffes, of whom the Theffalian were in the higheft eftimation. The means made ufe of were moft commonly philtres or love potions, the operation of which was violent and dangerous, and frequently deprived fuch as drank them of their reafon. Some of the moft remarkable ingredients of which they were compofed were: the hippomanes, the jynx, infects bred from putrefaction, the fifh remora, the lizard, brains of a calf, the hairs on the tip of a wolf's tail, his fecret parts, the bones of the left fide of a toad eaten with ants, the blood of doves, bones of fnakes, feathers of fcreech-owls, twifted cords of wool in which a perfon had hanged himfelf, rags, torches, reliques, a neft of fwallows buried and famifhed in the earth, bones fnatched from hungry bitches, the marrow of a boy famifhed in the midft of plenty, dried human liver; to thefe may be added feveral herbs growing out of putrid fubftances. Such were the ingredients that entered into the compofition of that infernal draught a *love potion*.

But, befides the philtres, various other arts were ufed to excite love, in which the application of certain fubftances was to have a magical influence on the perfon againft whom they levelled their fkill. A hyæna's udder worn under the left arm, they fancied would draw the affections of whatever woman they fixed their eyes upon. That fpecies of olives called πἰτυρα, and barley-bran made up into a pafte, and thrown into the fire, they thought would excite the flame of love. Flour was ufed with the fame intention. Burning laurel, and melted wax, were fuppofed to have the like effect. When one heart was to be hardened, and another mollified, clay and wax were expofed to the fame fire together. Images of wax were frequently ufed, reprefenting the perfons on whom they wifhed to make an impreffion; and whatever was done to the fubftitute of wax, they imagined was felt by the perfon reprefented. Enchanted medicaments were often fprinkled on fome part of the houfe where the perfon refided. Love-pledges were fuppofed to be of fingular ufe and efficacy: thefe they placed under their threfhold, to preferve the affections of the owner from wandering. Love-knots were of fingular power, and the number three was particularly obferved in all they did. But no good effect was expected, if the ufe of thefe things was not attended with charms or magical verfes and forms of words. See MAGIC.

Having mentioned their arts of exciting love, it may not be amifs to take notice, that the ancients imagined, that love excited by magic may be allayed by more powerful fpells and medicaments, or by applying to demons more powerful than thofe who had been concerned in raifing that paffion. But love infpired without magic had no cure; Apollo himfelf could find no remedy, but cried out

Hei mihi quod nullis amor eft medicabilis herbis.

The antidotes againft love were generally *agnus caftus*, which has the power of weakening the generative faculty; fprinkling the duft in which a mule had rolled herfelf; tying toads in the hide of a beaft newly flain; applying amulets of minerals or herbs, which were fuppofed of great efficacy in other cafes; and invoking the affiftance of the inferior deities. Another cure for love was bathing in the waters of the river Selemnus; to which we may add the lover's leap, or jumping down from the Leucadian promontory.

Love-Apple. See SOLANUM, BOTANY *Index*.

LOVENTINUM, or LUENTINUM, in *Ancient Geography*, a town of the Demeta in Britain, near the mouth of the Tuerobis or Tivy. Suppofed to have been afterwards fwallowed up by an earthquake, and to have ftood where is now the lake called *Llin Savatan* in Brecknockfhire.

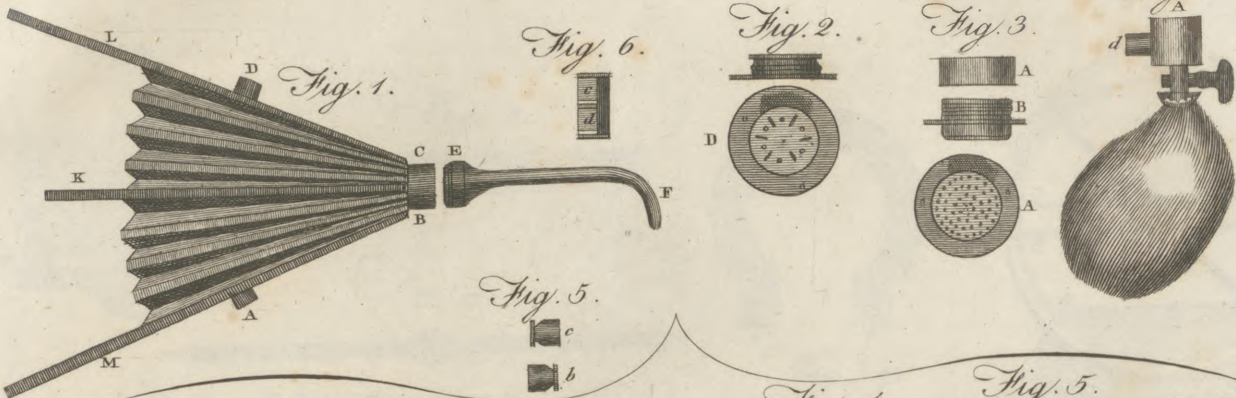
LOUGHBOROUGH, a town of Leicefterfhire in England, 110 miles from London. It is the fecond town in the county, and was in the Saxons time a royal village. Its market is on Thurfday; and its fairs are on April 25th, May 28th, Auguft 1ft, and November 2d. It has a large church, and a free fchool; befides a charity fchool for 80 boys, and another for 20 girls. It has been very much reduced by fires; but is ftill a very agreeable town, with rich meadow-ground, on the foffe, which runs here almoft parallel with the river Soar. The new canal has made the coal trade here very extenfive.

LOUGHBRICKLAND, a town of Ireland, fituated in the county of Down, and province of Ulfter, 58 miles from Dublin. The name fignifies the lake of the *fpeckled trout*; and it was fo called from a lake near it, which abounds with thofe fifh. It confifts of one broad ftreet, at the end of which is the parifh church, faid to have been built by Dr Taylor when bifhop of Dromore, foon after the Reftoration. The linen manufacture is carried on here very extenfively; and the town is a great thoroughfare, the turnpike road from Dublin to Belfaft paffing near it.

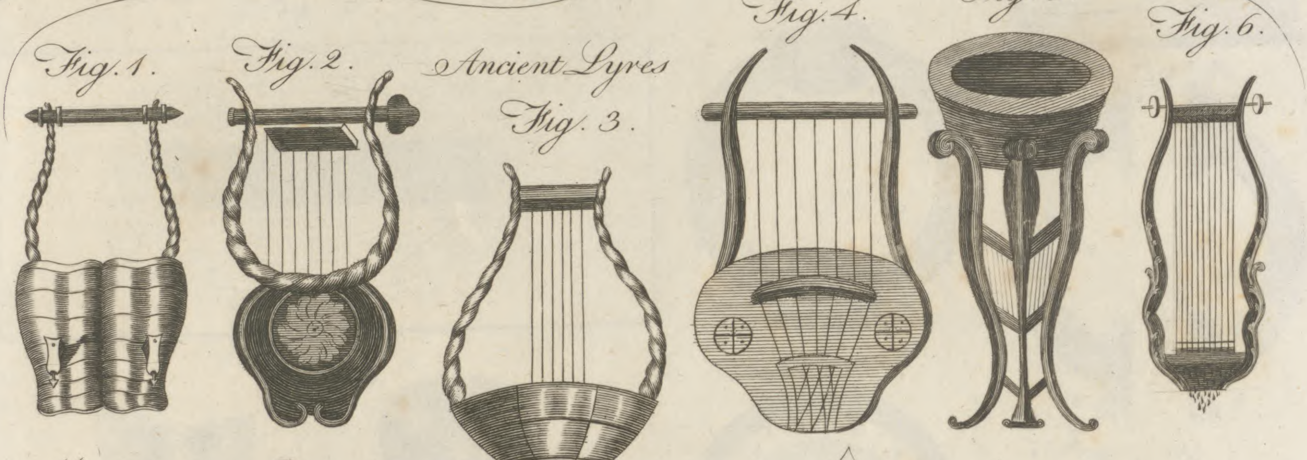
LOUGH-DERG, anciently *Derg-abhan*, i. e. "the river of the woody morafs," from a river which iffues out of this lake. This lough is fituated in the county of Donegal and province of Ulfter in Ireland, and is famous for having in it the ifland that contains St Patrick's purgatory, which is a narrow little cell, hewn out of the folid rock, in which a man could fcarce ftand upright. There is alfo a lake of this name fituated between the counties of Galway and Tipperary.

LOUGH-NEAGH, a loch or lake of Ireland, fituated in the counties of Armagh, Down, Derry, and Antrim, and province of Ulfter. It is the largeft in Europe,

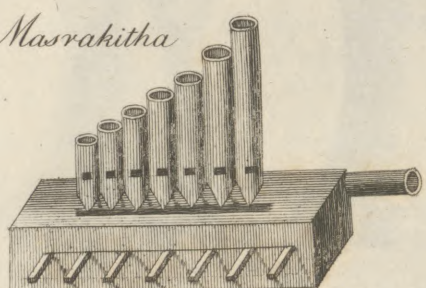
APPARATUS *for inflating the* LUNGS



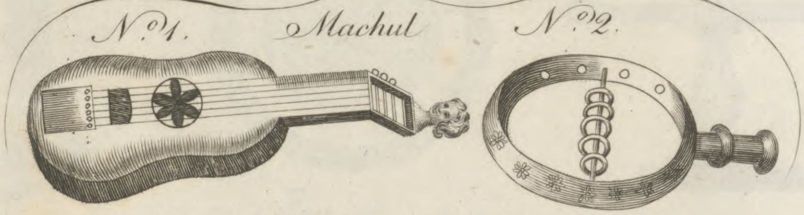
Ancient Lyres



Masrakitha



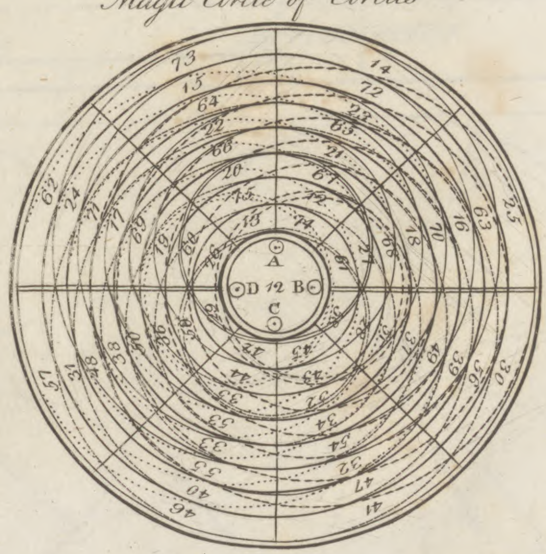
Machul



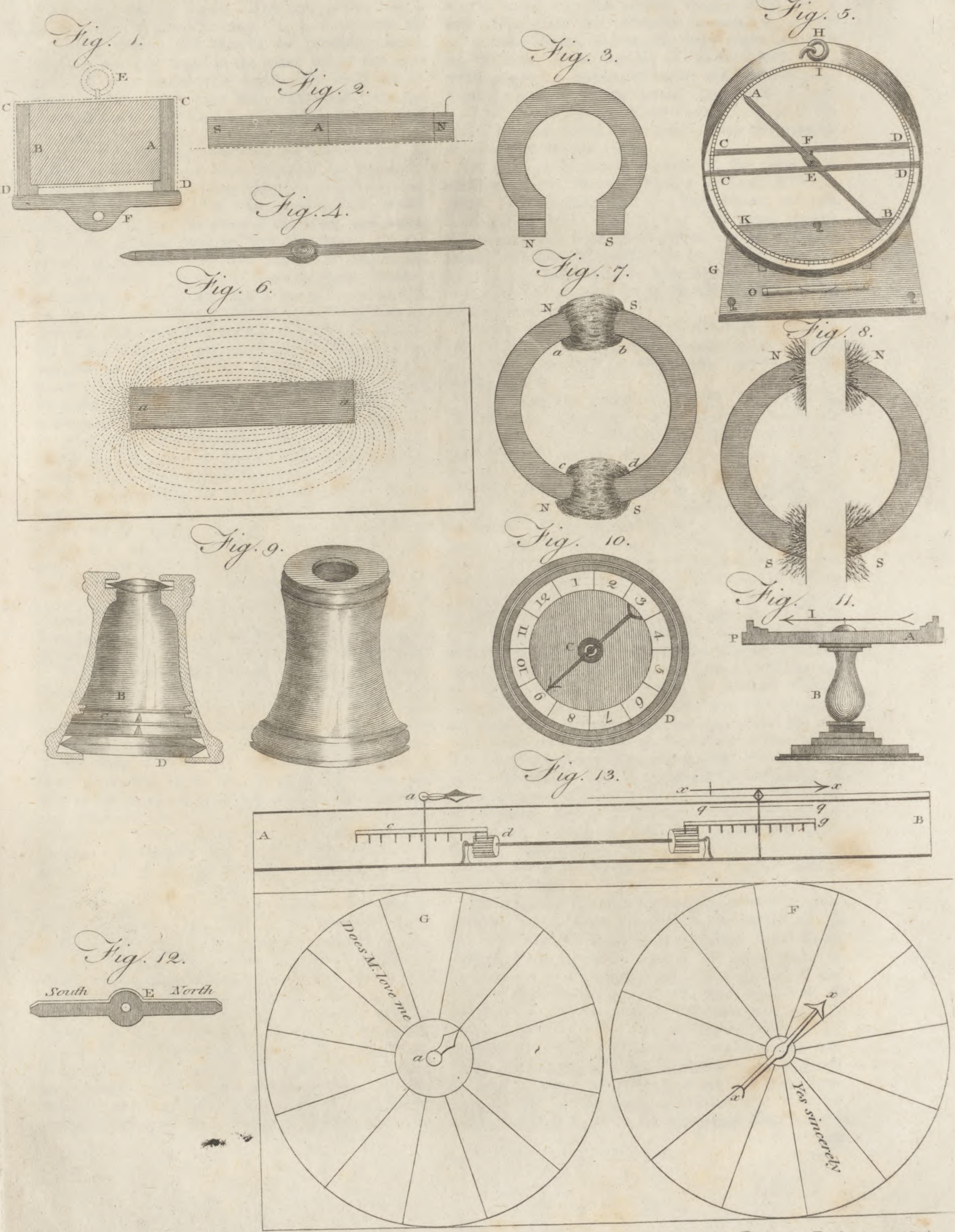
Magic Square of Squares

200	217	232	219	8	25	40	57	72	89	104	121	136	153	168	181
58	39	26	7	250	231	218	199	186	167	154	135	122	103	90	71
198	219	230	251	6	27	38	59	70	91	102	123	134	155	166	187
60	37	28	5	252	229	220	197	188	165	156	133	124	101	92	69
201	216	233	248	9	24	41	56	73	88	105	120	137	152	160	184
55	42	23	10	247	234	215	202	183	170	151	138	119	106	87	74
203	214	235	246	11	22	43	54	75	86	107	118	139	150	171	182
53	44	21	12	245	236	213	204	181	172	149	140	117	108	85	76
205	212	287	244	13	20	45	52	77	84	109	116	141	148	173	180
51	46	19	14	243	238	241	206	179	174	147	142	115	110	83	78
207	210	239	242	15	18	47	50	79	82	111	114	143	146	175	178
49	48	17	16	241	240	209	208	177	176	145	144	113	112	81	80
196	221	228	253	4	29	36	61	68	93	100	125	132	157	164	189
62	35	30	3	254	227	222	195	190	163	158	131	126	99	94	67
194	223	226	255	2	31	34	63	66	95	98	127	130	159	162	191
64	33	32	1	256	225	224	193	192	161	160	129	128	97	96	65

Magic Circle of Circles



A. Bell. Prin. Wall. Sculptor fecit.



A. Bell Prin. Wal. Sculptor fecit.

Lough-Neagh, Lough-Strangford.

Europe, those of Ladoga and Onega in Russia, and that of Geneva in Switzerland, excepted; being 20 miles long and 15 broad. The area of this lake is computed to be 100,000 acres. It is remarkable for a healing virtue; and likewise for petrifying wood, which is not only found in the water but in the adjacent soil at a considerable depth. On its shores several beautiful gems have been discovered. Its ancient name was *Loch Eacka*, or *Loch-Neach*, from *loch*, "a lake," and *Neach*, "wonderful, divine, or eminent." Its petrifying powers are not instantaneous, as several of the ancients have supposed, but require a long series of ages to bring them to perfection, and appear to be occasioned by a fine mud or sand, which insinuates itself into the pores of the wood, and which in process of time becomes hard like stone. On the borders of this lake is Shane's castle, the elegant seat of Lord O'Neil. Dr Smyth seems to doubt whether the healing quality in this lake is not to be confined to one side of it, called the *fishing-bank*; and he informs us, that this virtue was discovered in the reign of Charles II. in the instance of the son of one Mr Cunningham, who had an *evil* which run on him in eight or ten places; and notwithstanding all applications, seemed incurable: at length he was perfectly healed, after bathing in this lough about eight days. Hence that writer gives us another derivation of the name *Loch-Neach*, which (he says) seems to him to hint at this quality; *Neasg* or *Neas*, in Irish, signifying a sore or ulcer," which might not improbably be corrupted into *Neagh:* Hence he apprehends, this lake was remarked at a much earlier period for its healing property. As to its petrifying power, it is mentioned by Nenius, a writer of the 9th century, who says, "Est aliud stagnum quod facit ligna durescere in lapides. Homines autem findunt ligna, et postquam formaverunt, projiciunt in stagnum, et manent in eo usque ad caput anni, et in capite anni lapis invenitur; et vocatur stagnum *Luch-Echach*." Lough-Neach gives title of baron to the family of *Skeffington*.

LOUGH-STRANGFORD, a lake of Ireland, situated in the county of Down and province of Ulster. It takes its present name from a small port-town called *Strangford*, seated on the west side of the narrow entrance into the sea. It was formerly known by the name of *Lough-Cone* or *Lough-Coyne*. It is a deep bay or inlet of the sea, about 17 miles long and four or five broad; it goes west as far as Downpatrick, and north as far as Comber and Newton, and by computation covers 25,775 acres, Irish plantation measure. It abounds with excellent fish, particularly smelts; and off the bar there is a periodical herring fishery in or about August. The bar or entrance into this lough is about three miles below Strangford. There is a long rock at the entrance in the middle of the passage, dangerous to strangers on account of the current; yet there is a broad passage on either side, and deep water. The current here is very strong and rapid, running at the rate of six or seven miles an hour. There are but few vessels that go higher up than Strangford. A good many vessels bound up the Channel put in here, if the wind is unfavourable to their passage. The islands in this lake are numerous; Doctor Boat enumerates them at 260. But from an actual survey, made at the time Dr Smyth wrote his history of that county, it appears, there are 54 islands small and great, known by particular names, and many others nameless; the contents of these 54 islands added together amount to 954 acres and a half. The great and profitable manufacture carried on in these islands, and the flat stony coasts surrounding the lake, is the burning of sea-weed into kelp, which employs a number of hands, and has been computed to produce to the several proprietors a neat profit of 1000l. per annum and upwards. Four of the islands here are called *Swan islands* from the number of swans that frequent them.

Louis, Louisiana.

LOUIS, or St Louis, *Knights of*, the name of a military order in France, instituted by Louis XIV. in 1693. Their colours were of a flame colour, and pass from left to right; the king was their grand master. There were in it eight great crosses, and 24 commanders; the number of knights was not limited. At the time of their institution, the king charged his revenue with a fund of 900,000 livres for the pensions of the commanders and knights.

Louis, *Lewis*, *Louis d'or*, or *Lewidore*, a French coin, first struck in 1640, under the reign of Louis XIII. and which has now a considerable currency. See Money-*Table*.

LOUISIANA, formerly a Spanish province of N America, now belonging to the United States, is bounded on the east by the Mississippi, on the south by the gulf of Mexico, on the west by New Mexico, and on the north by boundaries which have not been defined. It is intersected by a number of fine rivers, and the greater part of the inhabitants are said to be Roman Catholics. They are chiefly the descendants of the French and Canadians; but in different settlements of this extensive country there are likewise to be met with the descendants of people from Germany, as well as numbers of Acadians and Americans. The population in 1785, when a census was taken, amounted to more than 50,000 souls; but different authors are of opinion that this is much below the proper estimate, notwithstanding the population bears no proportion to the extent of the country. According to another estimate there are 89,970. The inhabitants have often attempted to cultivate the sugar cane, but they found the climate rather unfavourable to the culture of that plant. They chiefly export indigo, cotton, rice, beans, myrtle, wax, and lumber. But if the climate is unfriendly to the sugar-cane, it is said to be favourable to the health of the people, and to the culture of fruits and garden vegetables. The total value of the exports from Louisiana in 1802 is said to have amounted to 2,158,000 dollars, and of the imports to about 342,000 dollars above that sum.

There are but few domestic manufactures of any importance in Louisiana, but such of the inhabitants as are denominated Acadians, manufacture some cotton into quilts and cottonades; and in the remote parts of the province, those planters who are poor, are in the habit of spinning cloth mixed with wool for the use of the negroes. In the parish of Iberville there is a machine for spinning cotton, and another in the Opeloufas, but neither of them very extensive; a considerable manufacture of cordage, twelve distilleries for making tafia, and a sugar refinery which manufactures about 200,000 lbs. of loaf sugar annually. The trade by sea is considerable, for in the year 1802 there entered the

Louisiana.

the river Mississippi 268 vessels of all descriptions, one of which belonged to France, 97 to Spain, and 170 to America; and 265 sailed from the Mississippi in the same year, three of which belonged to France, 104 to Spain, and 158 to America. The coasting trade is also considerable from Pensacola, Mobille, and the creeks and rivers falling into Lake Pontchartrain, from whence ship timber, charcoal, lime, pitch and tar, are conveyed to New Orleans, in which about 500 sloops and schooners from eight to 50 tons are frequently employed.

A return of the militia of Louisiana was made by the baron of Carondelet to the court of Spain, which made them amount to 10,340 men; but in this estimate were included several companies of volunteers, negroes, and even companies of privileged horse, or cavalry. There are not above 930 native Indians in this vast country, some of whom are employed by the settlers as boatmen on the Red river, and much esteemed for their friendship to the whites, for their bravery and generosity.

The fortifications which have been erected in Louisiana scarcely merit our attention. Fort St Louis is commanded by a lieutenant-colonel, with a handful of troops; Baton Rouge is extremely ill constructed, and contains about 50 men; Fort Plaquemines, about 12 leagues from the sea, is an irregular work built of bricks, and badly constructed, on the east side of the river Mississippi, having a ditch in front of the river, and defended on the lower side by a deep creek. It is defenceless behind, as those by whom it was erected had placed too much confidence in the swampiness of the ground, which is every day growing harder. It would be no difficult matter to take it by escalade, for by the negligence of the people it is fast falling into ruins. The small redoubt called Fort Bourbon, is generally under the command of a serjeant, with a very small company. Should a vessel attempt to pass without sending a boat on shore, she would be instantly fired upon.

When Louisiana was first ceded to Spain, it preserved many of the regulations peculiar to France; but the province afterwards came to be governed by the laws of Spain, and the ordinances formed expressly for the colony. The governor's court has a civil and military jurisdiction throughout the province. That of the lieutenant-governor has the same extent in civil cases only. There are two alcades, whose jurisdiction, civil and criminal, extends through the city of New Orleans and five leagues around it, where the parties have no *fuero militar*, or military privilege; those who have can transfer their causes to the governor. The tribunal of the alcade provincial has cognizance of criminal causes, where offences are committed in the country, or when the criminal takes refuge there, and in other specified cases. The ecclesiastical tribunal has jurisdiction in all matters respecting the church.

There are no colleges in Louisiana, and but one public school, which is at New Orleans, the masters of which receive their salary from the king. They teach nothing but the Spanish language, and there are a few private schools for the benefit of children. It is remarkable that not more than one-half of the inhabitants are supposed qualified to read and write, and of these it is said that not above 200 are capable of doing it well.

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The clergy consist of a bishop, who does not reside in the province, and whose salary of 4000 dollars is charged on the revenue of certain bishoprics in Mexico and Cuba; two canons have each a salary of 600 dollars; and 25 curates, five for the city of New Orleans, and 20 for as many country parishes, who receive about 400 dollars each. These salaries, exclusive of that of the bishop, are paid by the treasury at New Orleans, and their annual amount has been estimated at 13,000 dollars.

Louisiana
||
Louth.

Instead of paying local taxes, each inhabitant is bound to make and repair roads, bridges, and embankments through his own land. A duty of six per cent. is payable at the customhouse, on the transfer of shipping. It is ascertained upon the sum the buyer and seller declare to be the real consideration. As no oath is required from either, they seldom report more than half the price. Two per cent. is payable on legacies and inheritances, coming from collaterals, and exceeding 2000 dollars; four per cent. on legacies given to persons who are not relatives of the testator. A tax on civil employments, if their salaries exceed 300 dollars. A tax is levied of 40 dollars per annum for licenses to sell liquors, and six per cent. on all imports and exports, which amounts to about 120,000 dollars, while the amount of all the other taxes does not exceed 6000 dollars.

The expences of the government of Louisiana are said to amount to 650,000 dollars, to pay which there are 400,000 dollars sent annually from Vera Cruz, in consequence of which deficiency the debt is said at present to amount to 450,000 dollars, bearing no interest, and depreciated 30 per cent.

Soon after Louisiana was ceded to the United States, there were two societies established for the promotion of science and literature, one of them at New Orleans, and another at Natchez. The former designs to publish a monthly magazine for the purpose of diffusing a knowledge of the country, and to amuse the readers of it with a variety of useful subjects. The latter, which was established in 1803, called the Mississippi Society for the Acquirement and Dissemination of useful Knowledge, consists of near 40 members, and has correspondents in various parts of the United States. The American government has granted it a charter of incorporation.

LOUSE. See Pediculus, Entomology *Index*.

LOUSY disease. See Medicine *Index*.

LOUTH, a town of Lincolnshire in England, 156 miles from London. It is a town corporate; and one of the handsomest and gayest in the county, there being in it not only frequent assemblies, concerts, &c. but even masquerades. Here are several handsome houses. From hence there is a canal to the sea at Tilney, about eight miles. Besides a charity school for 40 children, it has a free school founded by Edward VI. with a large church, and a fine steeple, which some think is as high as Grantham spire, which is 288 feet.

Louth, a county in the eastern part of Ireland, which extends in the form of a bow or half-moon, on the side of the ocean, being much longer than it is broad; it is bounded on the south and south-west by the county of East Meath, on the north-west by Monaghan, on the north by Armagh, and on the north-east

east by the bay of Carlingford, which parts it from the county of Down: it is watered by several small rivers which fall into the sea; and its south frontiers are watered by the river Boyne. Its chief towns are Dundalk and Carlingford; unless we include Drogheda, a part whereof is in this county. It is the smallest county in the kingdom; but very fertile and pleasant, and abounding with many remains of antiquities, of which Mr Wright, in his Louthiana, has given a very ample description. It contains 111,180 Irish plantation acres, 50 parishes, five baronies, and five boroughs; and formerly returned 10 members to parliament: it is about 22 miles long, and 14 broad.

LOUTH, a town in the above county, having a yearly fair.

LOUVAIN, a city in the Austrian Netherlands, in the province of Brabant, pleasantly seated on the river Dyle, in a plentiful and agreeable country. The walls are about eight or nine miles in circumference; but they include several fields and vineyards. The castle stands on a high hill, surrounded with fine gardens, and has a charming prospect all over the country. This town contains nine market places, 14 water-mills, 126 streets, 16 stone bridges, and several handsome palaces. The townhouse is a venerable old building, adorned with statues on the outside; and the churches are very handsome, particularly the collegiate church of St Peter; but the principal ornament is the univerfity, founded only in 1426 by John IV. duke of Brabant, with the concurrence of Pope Martin V. It contains about 40 colleges, four of which are called *Pedagogia*. There is in the number also an English college of friars-preachers, which owes its establishment to the liberalities of Cardinal Philip Howard, brother to the duke of Norfolk, who, before he was raised to the purple, had been private chaplain to Queen Catherine, consort to Charles II. The Irish have likewise a seminary, erected in part under the care of Eugenius Mattheus, titular archbishop of Dublin, anno 1623, which receives its appointments from the Propaganda at Rome. Besides the above, there are two convents for the Irish, one of Recollects and the other of Dominicans, where divinity and the mathesis are taught. In the last century the number of scholars exceeded 4000; but in the year 1744 the inhabitants amounted to 12,000, including 2000 students only.—At the beginning of the 14th century, under John III. it flourished considerably in the manufacture of woollen cloth: 400 houses were then occupied by substantial clothiers, who gave employment to an incredible number of weavers, so great, it is said, that a bell was rung to prevent any injuries which the children in the street might receive from the crowd and hurry on their returning from work. In 1382, these weavers, however, took up arms, and rebelled against their sovereign Prince Wenceslaus, throwing from the windows of the town hall 17 of the aldermen and counsellors, and afterwards proceeded to lay waste great part of Brabant; but being besieged and reduced to great extremities, they submissively implored his clemency; which was granted after the execution of some of the principal ringleaders. The weavers, the chief instigators to this revolt, were banished, the greater part of whom took refuge in England; where they first introduced, or at least augmented very much, the woollen manufacture. The town, by this circumstance, being almost depopulated, the university was established to supply in some measure the loss of the rebellious clothiers. Since that time the manufacture gradually declined, no cloth of any account being made there at present. This impolitic step of the duke Wenceslaus sent treasures to England, through the hands of those exiled people: an important lesson to governors, that they should deal with great precaution respecting such useful members of the community. Upon the ruins of these looms was formed the cloth manufacture of Limbourg, which is carried on with good advantage to this day. There is yet standing at Louvain part of the old drapers-hall, now converted into four public schools, where lectures in divinity, philosophy, law, and physic, are given, and the public acts are made. Adjoining to the schools is the university library, which altogether compose a large pile of building. Over the door of the chief entrance we read these words, *Sapientia ædificavit sibi domum.* The principal church is collegiate, dedicated to St Peter, which had formerly three very large towers with elevated spires, one considerably higher than the two collaterals; these were blown down in the year recorded by this chronogram, *oMnIa CaDVnt*. From the name of this church the burghers have acquired the nickname of *Petermen*, whose ancestors having clothed the back by a noble woollen manufacture, the modern Petermen now compose an ignoble mixture for the belly, called after them *Peterman beer*, a sort of whitish muddy ale, which they notwithstanding send in large quantities to all parts of the country, as well as to Holland, by the canals. Louvain was anciently the capital of the province, long before Brussels had any claim to that title. It was taken by the French in 1792, afterwards lost, and retaken in 1794. E. Long. 4. 40. N. Lat. 51. 12.

LOUYS, or LOUIS, *John*, an engraver of considerable eminence, who flourished about the middle of the 16th century. According to Basan he was a native of Flanders. He learned the art of engraving from Peter Soutman, at the time that Suyderhoef studied under the same master; and his usual style of engraving bears some resemblance to that of his master's. One of his best prints is Diana, with her nymphs, reposing after the chase; a middling-sized plate, lengthwise, from Rubens.

LOW-BELL, in birding, a name given to a bell, by means of which they take birds in the night, in open champaign countries, and among stubble, in October. The method is to go out about nine o'clock at night in a still evening, when the air is mild and the moon does not shine. The low-bell should be of a deep and hollow sound, and of such a size that a man may conveniently carry it in one hand. The person who carries it is to make it toll all the way he goes, as nearly as may be, in that manner in which the bell on the neck of a sheep tolls as it goes on and feeds. There must also be a box made like a large lanthorn, about a foot square, and lined with tin, but with one side open. Two or three great lights are to be set in this; and the box is to be fixed to the person's breast, with the open side forwards, so that the light may be cast forward to a great distance. It will spread as it goes out of the box; and will distinctly show to the person that carries it whatever there is in the large space of ground over which it extends, and consequently all the birds that roost upon the ground. Two persons must follow him who carries the box and bell, one on each side, so as not to be within the reach of the light to show themselves. Each of these is to have a hand-net of about three or four feet square, fastened to a long stick or pole; and on whichever side any bird is seen at roost, the person who is nearest is to lay his net over it, and take it with as little noise as possible. When the net is over the bird, the person who laid it is not to be in a hurry to take the bird, but must stay till he who carries the light is got beyond it, that the motions may not be discovered. The blaze of the light and the noise of the bell terrify and amaze the birds in such a manner that they remain still to be taken; but the people who are about the work must keep the greatest quiet and stillness that may be.

Some people are fond of going on this scheme alone. The person then fixes the light box to his breast, and carries the bell in one hand and the net in the other; the net in this case may be somewhat smaller, and the handle shorter. When more than one are out at a time, it is always proper to carry a gun; as it is no uncommon thing to spy a hare when on this expedition.

LOW, East, a town of Cornwall in England, 231 miles from London, in the post road from Plymouth. It is an ancient borough by prescription, made a corporation by charter of Queen Elizabeth, consisting of nine burgesses (one of whom is yearly chosen mayor), a recorder, aldermen, &c.; and the mayor, magistrates, and freemen, who are about 68, choose the members of parliament. This being a manor of the duchy of Cornwall, was settled by King William on Lord Somers, and is now held by the corporation at the fee-farm rent of 20s. a-year. It is seated pretty commodiously on a creek of the sea, over which there is a large stone bridge, supported by 15 arches, which leads to West Low, standing between two hills. The chief benefit which the inhabitants have is in their fishery. Here is a battery of four guns and a small chapel.

Low, West, called also *Port Pigham*, a town of Cornwall, divided from East Low by a stone bridge of 15 arches over the river Low, from whence both towns receive their name, as the river does from the lowness of its current between its high banks. The corporation, by charter of Queen Elizabeth, consists of 12 burgesses, one of whom is annually chosen mayor, and, with the other burgesses, has power to choose a steward. Its members, whom it has sent to parliament ever since the 6th of Edward VI. are elected by the corporation and freemen, who are about 60. There was a chapel of ease here in the reign of Henry VIII. which was afterwards converted into a town-hall; and the town lying in the parish of Talland, the people go thither to church. There is a pretty little harbour here; near the mouth of which is a small island called *St George's*, which abounds with sea pies. The river here is navigable for vessels of 100 tons.

LOWER, Richard, an eminent English physician in the 17th century, was born in Cornwall, and educated at Westminster school and Oxford. He entered on the physic line; and practised under Dr Thomas Willis, whom he instructed in same parts of anatomy, especially when the latter was writing his *Cerebri Anatome.* He, with Dr Willis, in 1674, discovered the medicinal waters at Ashop in Northamptonshire; which, upon their recommendation, became very much frequented. In 1666 he followed Dr Willis to London; practised physic under him; and became fellow of the Royal Society, and of the College of Physicians. In 1669 he published his *Tractatus de Corde;* and, after the death of Dr Willis in 1675, he was esteemed the most eminent physician in London. Upon the breaking out of the Popish plot in 1678, says Mr Wood in his *Athenæ Oxonienses*, he closed with the Whigs, supposing that party would carry all before them; but, being mistaken, he lost his credit and practice. He died in 1691.

LOWERING, among distillers, a term used to express the debasing the strength of any spirituous liquor, by mixing water with it. The standard and marketable price of these liquors is fixed in regard to a certain strength in them called *proof;* this is that strength which makes them, when shaken in a phial or poured from on high into a glass, retain a froth or crown of bubbles for some time. In this state, spirits consist of about half pure or totally inflammable spirit, and half water; and if any foreign or home spirits are to be exposed to sale, and are found to have that proof wanting, scarce any body will buy it till it has been distilled again and brought to that strength; and if it is above that strength, the proprietor usually adds water to it to bring it down to that standard. See the article Proof.

There is another kind of lowering among the retailers of spirituous liquors to the vulgar, by reducing it under the standard proof. Whoever has the art of doing this without destroying the bubble proof, which is easily done by means of some addition that gives a greater tenacity to the parts of the spirits, will deceive all that judge by this proof alone. In this case, the best way to judge of liquors is by the eye and tongue, and especially by the instrument called Hydrometer.

LOWTH, William, D. D. a learned divine, born at London in 1661, was the son of an apothecary, and took his degrees at Oxford. His eminent worth and learning recommended him to Dr Mew bishop of Winchester, who made him his chaplain, gave him two livings in Hampshire, and conferred on him a prebend in the cathedral of Winchester. He acquired an unusual share of critical learning. Thus situated in life, the labours of Mr Lowth appear to have been strictly confined within the limits of his own province, and applied solely to the peculiar duties of his function: yet, in order that he might acquit himself the better in theology, he had pursued his studies with a more general and extensive view. Few were more deeply versed in critical learning; there being scarcely any ancient author, Greek or Latin, profane or ecclesiastical, especially the latter, but what he had read with accuracy, constantly accompanying his reading with critical and philological remarks. Of his collections in this way he was upon all occasions very communicative. Hence his notes on *Clemens Alexandrinus*, which are to be met with in Potter's edition of that father. Hence his remarks on *Josephus*, communicated

Lowth.

municated to Hudson for his edition, and acknowledged in the preface; as also those larger and more numerous annotations on the Ecclesiastical Historians, inserted in *Reading's* edition of them at Cambridge. The author of *Bibliotheca Biblica* was indebted to him for the same kind of assistance. Chandler, late bishop of Durham, while engaged in his "Defence of Christianity, from the Prophecies of the Old Testament, against the Discourse of the Grounds and Reasons of the Christian Religion," and in his "Vindication of the Defence, in answer to The Scheme of Literal Prophecy considered," held a constant correspondence with him, and consulted him upon many difficulties that occurred in the course of that work. The most valuable part of his character was that which least appeared in the eyes of the world, the private and retired part, that of the good Christian and the useful parish priest. His piety, his diligence, his hospitality and beneficence, rendered his life highly exemplary, and greatly enforced his public exhortations. He married Margaret, daughter of Robert Pitt, Esq. of Blandford, by whom he had two sons and three daughters. (See the next article). He died in 1732, and was buried by his own orders in the churchyard at Buriton. He published, 1. A Vindication of the Divine Authority and Inspiration of the Old and New Testaments; 2. Directions for the profitable reading of the Holy Scriptures; 3. Commentaries on the Prophets; and other works.

Lowth, *Robert*, D. D. second son of the preceding Dr William Lowth, and bishop successively of St David's, Oxford, and London, was born on the 29th of November 1710, probably at Buriton in the county of Hants. He received the rudiments of his education at Winchester college, where his school exercises were distinguished by uncommon elegance; and having resided the requisite number of years in that seminary, in 1730 he succeeded on the foundation at New College, Oxford. He took the degree of M. A. June 8. 1737. Though his abilities must have been known to those with whom he was connected, he was not forward to appear before the world as a writer. At Oxford he continued many years improving his talents, with little notice from the great, and with preferment so small as to have at present escaped the distinct recollection of some of his contemporaries.

He was not, however, suffered to languish for ever in obscurity. His genius and his learning forced themselves upon the notice of the illustrious society of which he was a member; and he was placed in a station where he was eminently qualified to shine. In 1741 he was elected by the university to the professorship of poetry, re-elected in 1743, and whilst he held that office he read his admirable lectures *De sacra poesi Hebræorum*. In 1744 Bishop Hoadley collated him to the rectory of Ovington in the county of Hants; added to it, nine years afterwards, the rectory of East Weedhay in the same county; and in the interim raised him to the dignity of archdeacon of Winchester. These repeated favours he some years afterwards acknowledged in the following manly and respectful terms of gratitude: "This address, My Lord, is not more necessary on account of the subject, than it is in respect of the author. Your Lordship, unsolicited and unasked, called him from one of those colleges to a station of the first dignity in your diocese, and took the earliest opportunity of accumulating your favour upon him, and of adding to that dignity a suitable support. These obligations he is now the more ready thus publicly to acknowledge, as he is removed out of the reach of further favours of the like kind. And though he hath relinquished the advantages so generously conferred on him, yet he shall always esteem himself highly honoured in having once enjoyed the patronage of the great advocate of civil and religious liberty."

On the 8th of July 1754 the university of Oxford conferred upon him the degree of D. D. by diploma; an honour which, as it is never granted but to distinguished merit, was probably conferred on Mr Lowth in consequence of his prelections on the Hebrew poetry, which had then been lately published. Having in 1749 travelled with Lord George and Lord Frederick Cavendish, he had a claim upon the patronage of the Devonshire family; and in 1755, the late duke being then lord lieutenant of Ireland, Dr Lowth went to that kingdom as his grace's first chaplain. Soon after this appointment he was offered the bishopric of Limerick; but preferring a less dignified station in his own country, he exchanged it with Dr Leslie, prebendary of Durham and rector of Sedgefield, for these preferments. In November 1765 he was chosen F. R. S. In June 1766 he was, on the death of Dr Squire, preferred to the bishopric of St David's; which, in the October following, he resigned for that of Oxford, vacant by the translation of Bishop Hume to Salisbury. In April 1777, he was translated to the see of London, vacant by the death of Bishop Terrick; and in 1783 he declined the offer of the primacy of all England.

Having been long afflicted with the stone, and having long borne the severest sufferings of pain and sickness with the most exemplary fortitude and resignation, this great and good man died at Fulham, Nov. 3. 1787; and on the 12th his remains were privately interred in a vault at Fulham church, near those of his predecessor. He had married in 1752, Mary, the daughter of Laurence Jackson of Christ-church, Hants, Esq. by whom he had two sons and five daughters. His lady and two children only survived him.

His literary character may be estimated from the value and the importance of his works; in the account of which we may begin with his *Prelections on the Hebrew Poetry*. The choice of so interesting a subject naturally attracted general attention; and the work has been read with equal applause abroad and at home. In these prelections the author has acquitted himself in the most masterly manner, as a poet, a critic, and a divine; and such is the classic purity of his Latin style, that though we have read the work with the closest attention, and with no other view than to discover, if possible, an Anglicism in the composition, we never found a single phrase to which, we believe, a critic of the Augustan age could possibly have objected. This is an excellence to which neither Milton nor Johnson has attained; to which indeed no other English writer of Latin with whom we are acquainted has attained, unless perhaps Atterbury must be excepted. To the prelections was subjoined a short confutation of Bishop Hare's system of Hebrew metre; which occasioned a Latin letter from Dr Edwards of Clare-hall;

Clare-hall, Cambridge, to Dr Lowth, in vindication of the Harian metre. To this the author of the prelections replied in a *larger confutation*, in which Bishop Hare's system is completely overthrown, and the fallacy upon which it was built accurately investigated. After much attentive consideration, Bishop Lowth has pronounced the metre of the Hebrews to be perfectly irrecoverable.

In 1758 he published *The life of William of Wykeham, bishop of Winchester*, with a dedication to Bishop Hoadley; which involved him in a dispute concerning a decision which that bishop had lately made respecting the wardenship of Winchester college. This controversy was on both sides carried on with such abilities, that, though relating to a private concern, it may yet be read, if not with pleasure, at least with improvement. The life of Wykeham is drawn from the most authentic sources; and affords much information concerning the manners, and some of the public transactions, of the period in which Wykeham lived, whilst it displays some private intelligence respecting the two literary societies of which he was the founder. In these two societies Dr Lowth was educated, and he gratefully expresses his obligations to them.

In 1762 was first published his *Short Introduction to English Grammar*, which has since gone through many editions. It was originally designed only for private and domestic use: but its judicious remarks being too valuable to be confined to a few, the book was given to the world; and the excellence of its method, which teaches what is right by showing what is wrong, has insured public approbation and very general use. In 1765 Dr Lowth was engaged with Bishop Warburton in a controversy, which made much noise at the time, which attracted the notice even of royalty, and of which the memory is still recent. If we do not wish to dwell on the particulars of this controversy, it is because violent literary contention is an evil, which, though like other war it may sometimes be unavoidable, is yet always to be regretted; and because the characters of learned, ingenious, and amiable men, never appear to less advantage than under the form which that state of hostility obliges them to assume. The two combatants indeed engaged with erudition and ingenuity such as is seldom brought into conflict; but it appears that, in the opinion of Dr Johnson, Warburton had the most scholastic learning, and that Lowth was the most correct scholar; that, in their contest with each other, neither of them had much argument, and that both were extremely abusive. We have heard, and we hope it is true, that they were afterwards reconciled, and expressed mutual regret for the violence of their past conduct.

In 1778 Bishop Lowth published his last great work, *A Translation of Isaiah*. To his literary and theological abilities, the translator joined the most critical knowledge of the character and spirit of the eastern poetry; and, accordingly, the prophecies of Isaiah (which, though almost always sublime or elegant, are yet sometimes obscure) were translated in a manner adequate to the highest expectations of the public. Several occasional discourses, which the bishop, by his station, was at different times called upon to deliver, were of course published, and are all worthy of their excellent author; but there is one on the *kingdom of God*, on the extension and progressive improvement of Christ's religion, and on the means of promoting these by the advancement of religious knowledge, by freedom of inquiry, by toleration, and mutual charity, which may be distinguished above the rest, as exhibiting a most comprehensive view of the successive states of the Christian church, and containing the truest principles of Christianity.

Of the bishop's poetical pieces, none display greater merit than Verses on the Genealogy of Christ, and the Choice of Hercules, both written very early in his life. He wrote a spirited Imitation of an Ode of Horace, applied to the alarming situation of this country in 1745; and likewise some Verses on the death of Frederic prince of Wales, with a few smaller poems. The following inscription on the tomb of his daughter, beautifully displays his paternal affection and classic taste. As it is short, and, in our opinion, has all the merit of the ancient epitaph, the reader will probably be pleased with such a specimen of his lordship's Latinity.

Cara, vale, ingenio præstans, pietate, pudore,
Et plusquam natæ nomine cara, vale.
Cara Maria, vale. At veniet felicius ævum,
Quando iterum tecum, sim modo dignus, ero.
Cara, redi, læta tum dicam voce, paternos,
Eja, age in amplexus, cara Maria, redi.

Learning and taste, however, did not constitute Bishop Lowth's highest excellence. Eulogium itself can scarcely ascend to extravagance when speaking of him either as a private man or as a pastor of the church of Christ. His amiable manners rendered him an ornament to his high station, whilst they endeared him to all with whom he conversed; and his zeal for the interests of true religion made him eager to promote to places of trust and dignity such clergymen as he knew were best qualified to fill them. Of his modesty, gentleness, and pleasing conversation, we have the testimony of one whose decision will hardly be disputed.—"It would answer no end (says Bishop Warburton) to tell you what I thought of the author of Hebrew poetry, before I saw him. But this I may say, I was never more surprised, when I did see him, than to find him of such amiable and gentle manners, of so modest, sensible, and disengaged a deportment." He united, indeed, in an eminent degree, the qualities of the gentleman with those of the scholar: he conversed with elegance, as he wrote with accuracy. As a husband, a father, or the master of a family, he was as nearly faultless as the imperfections of humanity will easily permit. His temper, when roused by what he thought improper conduct was indeed susceptible of considerable warmth; but if he could be highly offended, upon a slight concession he could likewise forgive. His heart was tender and sympathetic. He possessed a mind which felt its own strength, and decided on whatever came before it with promptitude and firmness. In those trials where affliction was to be suffered or subdued, he behaved as a man and a Christian. His piety had no tincture of moroseness; his charity no leaven of ostentation. To his whole diocese he was endeared by his laudable discretion and his useful zeal. To the world he was a benefit by his exemplary life and his splendid abilities. And whilst virtue and learning are reverenced

reverenced among men, the memory of Lowth will be respected and admired.

LOXIA, a genus of birds of the order of passeres. See ORNITHOLOGY *Index*.

LOYOLA, IGNATIUS. See IGNATIUS.

LOZENGE, in *Heraldry*, a four-cornered figure, resembling a pane of glass in old casements. See HERALDRY. Though all heralds agree, that single ladies are to place their arms on lozenges, yet they differ with respect to the causes that gave rise to it. Plutarch says, in the life of Theseus, that in Megara, an ancient town of Greece, the tomb-stones, under which the bodies of the Amazons lay, were shaped after that form; which some conjecture to be the cause why ladies have their arms on lozenges. *S. Petra Sancta* will have this shield to represent a *cushion*, whereupon women used to sit and spin, or do other housewifery. Sir J. Ferne thinks it is formed from the shield called *tessera*, which the Romans finding unfit for war, did allow to women to place their ensigns upon, with one of its angles always uppermost.

LOZENGES, among jewellers, are common to brilliant and rose diamonds. In brilliants, they are formed by the meeting of the skill and star facets on the bezil; in the latter, by the meeting of the facets in the horizontal ribs of the crown. See FACETS.

LOZENGE is also a form of medicine, made into small pieces, to be held or chewed in the mouth till they are melted there: the same with what are otherwise called *trochisci*, "troches."

LUBEC, a city and port-town of Germany, in the circle of Lower Saxony and duchy of Holstein, in E. Long. 10. 35. N. Lat. 54. 20. It stands at the conflux of several rivers, the largest of which is the Trave, 12 miles from the Baltic, where it has a fine harbour, and 40 north-east of Hamburgh. By the Steckenitz, another of those rivers, it has a communication with the Elbe, and consequently with the German ocean. The city lies on the side of a hill, with the Trave, increased by the Steckenitz on the one side, and the Wakenitz on the other; and is strongly fortified with bastions, moats, walls, and ramparts; the last of which are planted with trees, and form an agreeable walk. Lubec being formerly the chief of the Hanse towns, was very powerful in consequence of the vast trade it carried on; but a great part of that trade is now transferred to Hamburgh; however, it is still said to employ 150 of its own ships, and has a great share of the Baltic trade. It is about two miles in length, and more than one in breadth. The houses are all of stone, but old fashioned. Several of the streets have on each side rows of lime trees, with canals in the middle, like those of Holland. The public structures consist of the ancient cathedral of the bishopric of Lubec, and several other Lutheran churches; a nunnery for 22 ladies, with an abbess and prioress; a poor-house, an alms-house, and house of correction; an orphan-house, an hospital dedicated to the Holy Ghost; a house in which poor travellers are entertained three days, and then sent forward with a pass; but such as happen to be sick, are provided with all necessaries till they recover or die; the city armoury, a grammar-school of seven classes, the Calvinist church, and the Popish chapel. The deputies of the Hanse-towns used to meet here formerly in the townhouse. An alliance still subsists between Lubec, Hamburgh, and Bremen; and these cities, under the name of *Hanse towns*, negotiate treaties with foreign powers. Here are divers manufactures, and the city's territory is about 60 miles in compass. In the diet of the empire Lubec is possessed of the third seat among the Rhenish imperial cities; and among those of the circle, has the first. In the matricula, its assessment is 480 florins, and to the chamber of Wetzlar it pays 557 rixdollars and 88 kruitzers. The city is a republic within itself, and both makes and executes laws in regard to civil and criminal matters, &c. A father and son, or two brothers, cannot be in the regency at the same time. The famous league of the Hanse-towns was begun here in 1164. This city had its charter of privileges from the emperor Frederic II. Formerly it carried on wars, both offensive and defensive, for several years, not only against the dukes of Mecklenburg, but against the kings of Sweden and Denmark; particularly in 1428, when it fitted out 250 ships of force against Eric X. king of Denmark. There are about 20 churches in Lubec, with lofty steeples or spires. The Trave brings ships of burden into the very heart of the city; but the largest unload at Travemunde, i. e. the mouth of the Trave, eight or ten miles distant. Formerly it is said to have employed no less than 600 ships. In the famous cellar here, it is said, there is wine 200 years old. The church of St Mary's, a noble lofty pile, is supported by tall pillars, all of one stone each, and has a high spire, covered with gilt lead. The town's garrison consists of about 700 or 800 men. The revenue of its Lutheran bishop, though he is a prince of the empire, is said not to exceed 3000l. Lubec fell into the hands of the French in 1806, when Bonaparte overran the Prussian dominions; and many of the inhabitants were cruelly massacred and plundered.

LUBEN, a town of Germany, in the marquisate of Lower Lusatia. It is situated on the river Spree, and is the capital of a small circle of the same name. It is the seat of the diets, and of the chief tribunals and offices; and has several churches, with a noble land-house and hospital. E. Long. 14. 25. N. Lat. 52.

LUBIENIETSKI, STANISLAUS, a Polish gentleman, descended from a noble family, and born at Cracow in 1623, was educated by his father with great attention. He became a celebrated Socinian minister; and took great pains to obtain a toleration from the German princes for his Socinian brethren. His labours, however, were ineffectual; being himself persecuted by the Lutheran ministers, and banished from place to place; until at length he was banished out of the world, with his two daughters, by poison, his wife narrowly escaping, in 1675. We have of his writing A History of the Reformation in Poland; A Treatise on Comets; with other works, in Latin.

LUBIN, EILHARD, was professor of poetry in the university of Rostock in 1595; and ten years afterwards was promoted to the professorship of divinity. He wrote notes on Anacreon, Juvenal, Persius, &c. and several other works; but that which made the most noise is a treatise on the nature and origin of evil, entitled *Phosphorus de Causa prima et Natura Mali*, printed at Rostock in 1596; in which we have a curious hypothesis to account for the origin of moral evil.

He ſuppoſed two co-eternal principles, not *matter* and *vacuum*, as Epicurus did; but God, and *Nihilum* or *Nothing*. This being publiſhed againſt by Grawer, was defended by Lubin; but after all he is deemed better acquainted with polite literature than with divinity. He died in 1621.

LUBLIN, a handſome and conſiderable town of Poland, capital of the palatinate of the ſame name, with a citadel, a biſhop's ſee, an univerſity, and a handſome Jewiſh ſynagogue. Here the judicial courts for all Poland are held. It has three fairs, frequented by merchants from all nations. It is ſeated on the river Byſtrzna. E. Long. 22. 31. N. Lat. 51. 26.

LUCA, in *Ancient Geography*, a town of Etruria, on the river Aufer; a colony and a municipium. Now *Lucca*, capital of the republic of that name, near the river Sechia. E. Long. 11. 20. N. Lat. 43. 45.

LUCANIA, a country of Italy, and a part of Magna Græcia; bounded on the north by the river Silarus by which it was ſeparated from the Picentini, and by the river Bradanus by which it was parted from the Apuli Peucetii, on the ſouth by the Laüs, which ſeparated it from the Bruttii; on the eaſt by the Sinus Tarentinus; and on the weſt by the Tuſcan ſea. *Lucani*, the people, deſcendants of the Samnites. *Lucanus* the epithet, (Horace). *Lucæ boves* denoted elephants; firſt ſeen in Pyrrhus's wars in Lucania, whence the appellation (Pliny).

LUCANUS, Marcus Annæus, a Latin poet, born at Corduba in Spain, about A. C. 39. He was the ſon of Annæus Mela, the youngeſt brother of Seneca; and was conveyed to Rome from the place of his nativity at the age of eight months; a circumſtance, as his more indulgent critics obſerve, which ſufficiently refutes the cenſure of thoſe who conſider his language as provincial. At Rome he was educated under the Stoic Cornutus, ſo warmly celebrated by his diſciple Perſius the ſatiriſt, who was the intimate friend of our poet. In the cloſe of his education, Lucan is ſaid to have paſſed ſome time at Athens. On his return to Rome he roſe to the office of quæſtor, before he had attained the legal age. He was afterwards enrolled among the augurs; and married a lady of noble birth, and of a moſt amiable character. Lucan had for ſome time been admitted to familiarity with Nero, when the emperor choſe to contend for poetical honours by the public recital of a poem he had compoſed on Niobe; and ſome verſes of his imperial production are ſuppoſed to be preſerved in the firſt ſatire of Perſius. Lucan had the hardineſs to repeat a poem on Orpheus, in competition with that of Nero; and, what is more remarkable, the judges of the conteſt were juſt and bold enough to decide againſt the emperor. From hence Nero became the perſecutor of his ſucceſsful rival, and forbade him to produce any poetry in public. The well known conſpiracy of Piſo againſt the tyrant ſoon followed; and Tacitus, with his uſual ſarcaſtic ſeverity, concludes that Lucan engaged in the enterpriſe from the poetical injuries he had received: "a remark (ſays Mr Hayley*, who has endeavoured to refute the imputation) which does little credit to the candour of the hiſtorian; who might have found a much nobler, and, I will add, a more probable motive for his conduct in the generous ardour of his character, and his paſſionate adoration of freedom. In the ſequel of his narration, Tacitus alleges a charge againſt our poet, which, if it were true, muſt lead us to deteſt him as the moſt abject of mankind. The hiſtorian aſſerts, that Lucan, when accuſed of the conſpiracy, for ſome time denied the charge; but corrupted at laſt by a promiſe of impunity, and deſirous to atone for the tardineſs of his confeſſion, accuſed his mother Atilla as his accomplice. This circumſtance is ſo improbable in itſelf, and ſo little conſonant to the general character of Lucan, that ſome writers have treated it with contempt, as a calumny invented by Nero, to vilify the object of his envious abhorrence. But the name of Tacitus has given ſuch an air of authority to the ſtory, that it may ſeem to deſerve a more ſerious diſcuſſion, particularly as there are two ſubſequent events related by the ſame hiſtorian, which have a tendency to invalidate the accuſation ſo injurious to our poet. The events I mean are, the fate of Annæus, and the eſcape of Atilla, the two parents of Lucan. The former died in conſequence of an accuſation brought againſt him, after the death of his ſon, by Fabius Romanus, who had been an intimate with Lucan, and forged ſome letters in his name, with the deſign of proving his father concerned in the conſpiracy. Theſe letters were produced to Nero, who ſent them to Annæus, from an eager deſire, ſays Tacitus, to get poſſeſſion of his wealth. From this fact two inferences may be drawn, according to the different lights in which it may be conſidered:—If the accuſation againſt Annæus was juſt, it is clear that Lucan had not betrayed his father, and he appears the leſs likely to have endangered by his confeſſion the life of a parent, to whom he owed a ſtill tenderer regard:—If Annæus was not involved in the conſpiracy, and merely put to death by Nero for the ſake of his treaſure, we may the more readily believe, that the tyrant who murdered the father from avarice, might calumniate the ſon from envy. But the eſcape of Atilla affords us the ſtrongeſt reaſon to conclude that Lucan was perfectly innocent of the abject and unnatural treachery of which Tacitus has ſuppoſed him guilty. Had the poet really named his mother as an accomplice, would the vindictive and ſanguinary Nero have ſpared the life of a woman whoſe family he deteſted, particularly when other females were put to death for their ſhare in the conſpiracy? That Atilla was not in that number, the hiſtorian himſelf informs us in the following remarkable ſentence, "Atilla mater Annæi Lucani, ſine abſolutione, ſine ſupplicio, diſſimulata;" thus tranſlated by Gordon: "The information againſt Atilla, the mother of Lucan, was diſſembled; and, without being cleared, ſhe eſcaped unpuniſhed."

* In the *Notes* to his *Second Epiſtle* on *Epic Poetry*.

The preceding remarks will, our author hopes, vindicate to every candid mind the honour of Lucan, whoſe firmneſs and intrepidity of character are indeed very forcibly diſplayed in that picture of his death which Tacitus himſelf has given us. He was condemned to have his veins cut, as his uncle Seneca had before him. Lucan, "while his blood iſſued in ſtreams, perceiving his feet and hands to grow cold and ſtiffen, and life to retire by little and little from the extremities, while his heart was ſtill beating with vital warmth, and his faculties nowiſe impaired, recollected ſome lines of his own, which deſcribed a wounded ſoldier expiring in a manner that reſembled this. The lines themſelves he rehearſed; and they were the laſt words he he ever uttered." The critics differ concerning the verses of the Pharsalia which the author quoted in so memorable a manner. The two passages he is supposed to have repeated are the following; of which Lipsius contends for the latter.

Sanguis erant lachrymæ: quæcunque foramina nova
Humor, ab his largus manat cruor: ora redundant,
Et patulæ nares: sudor rubet: omnia plenis
Membra fluunt venis: totum est pro vulnere corpus.
Lib. ix. v. 814.

Now the warm blood at once, from every part
Ran purple poison down, and drain'd the fainting heart.
Blood falls for tears; and o'er his mournful face
The ruddy drops their tainted passage trace.
Where'er the liquid juices find a way,
There streams of blood, there crimson rivers stray,
His mouth and gushing nostrils pour a flood,
And e'en the pores ooze out the trickling blood;
In the red deluge all the parts lie drown'd,
And the whole body seems one bleeding wound. ROWE.

Scinditur avulsus; nec sicut vulnere sanguis
Emicuit lentus; ruptis cadit undique venis,
Discursusque animæ, diversa in membra meantis,
Interceptus aquis. Lib. iii. v. 638.

No single wound the gaping rupture seems,
Where trickling crimson wells in slender streams;
But, from an op'ning horrible and wide,
A thousand vessels pour the bursting tide:
At once the winding channel's course was broke,
Where wand'ring life her mazy journey took;
At once the currents all forgot their way,
And lost their purple in the azure sea. ROWE.

Such was the death of Lucan before he had completed his 27th year.—His wife, Polla Argentaria, is said to have transcribed and corrected the three first books of the Pharsalia after his death. It is much to be regretted (Mr Hayley observes) that we possess not the poem which he wrote on the merits of this amiable and accomplished woman; but her name is immortalized by two surviving poets of that age. The veneration which she paid to the memory of her husband is recorded by Martial; and more poetically described in that pleasing and elegant little production of Statius, *Genethliacon Lucani*, a poem said to have been written at the request of Argentaria. The author, after invoking the poetical deities to attend the ceremony, touches with great delicacy and spirit on the compositions of Lucan's childhood, which are lost, and the Pharsalia, the production of his early youth: he then pays a short compliment to the beauty and talents of Argentaria; laments the cruel fate which deprived her so immaturely of domestic happiness; and concludes with an address to the shade of Lucan, which, with Mr Hayley's translation, we shall subjoin in a Note, as it seems to furnish a strong presumption of Lucan's innocence in regard to one of the accusations mentioned above (A). "Had he been really guilty of basely endangering

(A)

At tu, seu rapidum poli per axem
Famæ curribus arduis levatus,
Qua surgunt animæ potentiores,
Terras despicis et sepulchra rides:
Seu pacis meritum nemus reclusæ
Felix Elysiis tenes in oris,
Quo Pharsalica turba congregatur;
Et te nobile carmen insonantem
Pompeii comitantur et Catones:
Tu magna sacer et superbus umbra
Nescis Tartaron, et procul nocentum
Audis verbera, pallidumque visa
Matris lampade respicis Neronem.
Adsis lucidus; et vocante Polla
Unam, quæso, diem deos silentum
Exores; solet hoc patere limen
Ad nuptas redeuntibus maritis.
Hæc te non thiasis procax dolosis
Falsi numinis induit figuras;
Ipsum sed colit, et frequentat ipsum
Imis altius insitum medullis;
Ac solatia vana subministrat
Vultus, qui simili notatus, auro
Stratis prænitet, excubatque somno
Securæ. Procul hinc abite mortes;
Hæc vitæ genitalis est origo;
Cedat luctus atrox, genisque manent
Jam dulces lachrymæ, dolorque festus
Quicquid fleverat ante nunc adoret.

But you, O! whether to the skies
On Fame's triumphant car you rise,
(Where mightier souls new life assume)
And mock the confines of the tomb;
Or whether in Elysium blest
You grace the groves of sacred rest,
Where the Pharsalian heroes dwell;
And, as you strike your epic shell,
The Pompeys and the Catos throng
To catch the animating song;
Of Tartarus the dread controul
Binds not your high and hallow'd soul:
Distant you hear that wailing coast,
And see the guilty Nero's ghost
Grow pale with anguish and affright,
His mother flashing on his sight.
Be present to your Polla's vows,
While to your honour'd name she bows!
One day let your entreaties gain
From those who rule the shadowy train!
Their gates have op'd to bless a wife,
And given a husband back to life.
In you the tender fair invites
No fancied god with frantic rites:
You are the object of her prayers,
You in her inmost heart she bears:
And stampt on mimic gold, your head
Adorns the faithful mourner's bed,
And sooths her eyes before they close,
The guardian of her chaste repose.
Away with all funereal state!
From hence his nobler life we date:
Let mourning change the pang severe,
To fond devotion's grateful tear!
And festal grief, its anguish o'er,
What it lamented, now adore!

endangering the life of his mother (says Mr Hayley), it is not probable that his wife would have honoured his memory with such enthusiastic veneration; or that Statius, in verses designed to do him honour, would have alluded to *the mother* of Nero. If his character as a man has been injured by the historian (continues Mr Hayley), his poetical reputation has been treated not less injuriously by the critics. Quintilian, by a frivolous distinction, disputes his title to be classed among the poets; and Scaliger says, with a brutality of language disgraceful only to himself, that he seems rather to *bark* than to *sing*. But these insults may appear amply compensated, when we remember, that in the most polished nations of modern Europe, the most elevated and poetic spirits have been his warmest admirers; that in France he was idolized by Corneille, and in England translated by Rowe.—The severest censures on Lucan have proceeded from those who have unfairly compared his language to that of Virgil: but how unjust and absurd is such a comparison! it is comparing an uneven block of porphyry, taken rough from the quarry, to the most beautiful superficies of polished marble. How differently should we think of Virgil as a poet, if we possessed only the verses which he wrote at that period of life when Lucan composed his Pharsalia! In the disposition of his subject, in the propriety and elegance of diction, he is undoubtedly far inferior to Virgil; but if we attend to the bold originality of his design, and to the vigour of his sentiments; if we consider the Pharsalia as the rapid and uncorrected sketch of a young poet, executed in an age when the spirit of his countrymen was broken, and their taste in literature corrupted; it may justly be esteemed as one of the most noble and most wonderful productions of the human mind."—Lucan wrote several poems; but we have none remaining beside his *Pharsalia*, of which an excellent English version has been given by Mr Nicholas Rowe.

Lucanus, the *Stag-Beetle*, a genus of insects of the order of coleoptera. See Entomology *Index*.

LUCAR de Barameda (St), a handsome and considerable town of Spain, with a very good harbour, well defended, in Andalusia. It was once the greatest port in Spain, before the galleons unloaded their treasure at Cadiz. It is seated at the mouth of the river Guadalquiver. W. Long. 6. 5. N. Lat. 36. 40.

Lucar de Guadiana (St), a strong town of Spain, in Andalusia, on the confines of Algarve; seated on the river Guadiana, with a little harbour. W. Long. 5. 59. N. Lat. 37. 32.

Lucar la Major (St), a small town of Spain, in Andalusia, with the title of a duchy. It is seated on the river Guadiana, in W. Long. 6. 32. N. Lat. 37. 21.

LUCARIA, a feast celebrated at Rome on the 18th of July, in memory of the flight of the Romans into a great wood, where they found an asylum, and saved themselves from destruction. This wood, in which they found protection, was situated between the Tyber and the *Via Salaria*. The enemies from whom the Romans fled were the Gauls.—On this festival, Plutarch tells us, it was customary to pay the actors, and such as contributed to the public amusement, with the money arising from the selling of wood. This money was called *lucar*. It is obvious, from what has been observed, that *lucar* and *lucaria* are derived from *lucus*, a grove.

LUCAS Jacobs, an eminent artist, more generally known by the name of *Lucas van Leyden*, or *Hugense*, was born at Leyden in 1494. He received his first instructions in the art of painting from his father Hugues Jacobs; but completed his studies in the school of Cornelius Engelbrecht. He gained much money by his profession; and being of a generous turn of mind, he spent it freely, dressed well, and lived in a superior style. It is said, that, a few years before his death, he made a tour into Zealand and Brabant; and during his journey, a painter of Flushing, envious of his great abilities, gave him poison at an entertainment; which, though very slow, was too fatal in its effect, and put an end to his life, after six years languishing under its cruel influence. Others, denying the story of the poison, attribute his death to his incessant industry. The superiority of this artist's genius manifested itself in his infancy: for his works, even from the age of nine, were so excellent as to excite the admiration of all cotemporary artists; and when he was about 15, he painted a St Hubert, which gained him great applause. His tone of colouring (Mr Pilkington observes) is good; his attitudes (making a reasonable allowance for the stiff German taste) are well chosen; his figures have a considerable expression in their faces, and his pictures are very highly finished. He endeavoured to proportion the strength of his colouring to the different degrees of distance in which his objects were placed: for in that early time, the true principles of perspective were but little known, and the practice of it was much less observed. In the town hall at Leyden, the most capital picture of Lucas, the subject of which is the Last Judgement, is preserved with great care; the magistrates having refused very large sums which have been offered for it.

This artist painted not only in oil, but also in distemper and upon glass. Nor was he less eminent for his engraving than for his painting. He carried on a familiar and friendly correspondence with Albert Durer, who was his cotemporary; and, it is said, that as regularly as Albert Durer published one print, Lucas published another, without the least jealousy on either side, or wish to depreciate each other's merit. And when Albert came into Holland upon his travels, he was received by Lucas in a most cordial and affectionate manner. His style of engraving, however, according to Mr Strutt, differed considerably from that of Albert Durer, "and seems evidently to have been founded upon the works of Israel van Mechlen. His prints are very neat and clear, but without any powerful effect. The strokes are as fine and delicate upon the objects in the front, as upon those in the distances; and this want of variety, joined with the feebleness of the masses of shadow, give his engravings, with all their neatness, an unfinished appearance, much unlike the firm substantial effect which we find in the works of Albert Durer. He was attentive to the minutiæ of his art. Every thing is carefully made out in his prints, and no part of them is neglected. He gave great character and expression to the heads of his figures; but on examination of his works, we find the same heads

heads too often repeated. The hands and feet are rather mannered than correct; and when he attempted to draw the naked figure, he succeeded but very indifferently. He affected to make the folds of his draperies long and flowing; but his female figures are frequently so excessively loaded with girdles, bandages, and other ornamental trappings, that much of the elegance of the design is lost. He engraved on wood, as well as on copper; but his works on the former are by no means numerous. They are, however, very spirited; though not equal, upon the whole, to those of his friend Albert. The prints of this master are pretty numerous, but very seldom met with complete; especially fine impressions of them. For though they are, generally speaking, executed with the graver only, yet, from the delicacy of the execution, they soon suffered in the printing. Of his engravings the few following may be mentioned as among the principal. 1. *Mahomet sleeping, with a priest murdered by his side, and another figure stealing his sword*, a middling-sized upright plate, dated 1508, said to be one of his most early productions. 2. An *ecce homo*, a large plate, lengthwise, dated 1510. 3. *The crucifixion on Mount Calvary*, the same. 4. *The wise men's offering*, the same, dated 1513. 5. *Return of the prodigal son*, a middling sized plate, lengthwise, dated 1518. 6. A large print lengthwise, called *the dance of Magdalen*, dated 1519. 7. His own *portrait*, a small upright plate, dated 1525. 8. *David playing before Saul*, a middling-sized upright plate, dated———. This is a very fine print; the expression of Saul's countenance, in particular, is admirable. 9. A print known by the name of *Ulespiegle*, which is the scarcest of all the works of this master. It is in the collection of the king of France; and said by Marolles, and other masters, to be unique. But Basan informs us, that M. Mariette had also an impression of this plate; and it has been since found in one or two other collections. It represents a travelling bagpiper with his family; himself playing as he goes along, and carrying two children in a basket at his back; his wife trudging by his side, supporting with one hand an infant on her shoulder, and with the other leading an ass loaded with two baskets, having two children in each; and another child going before, with a little dog, completes the singular groupe. This rare print is dated 1520, and is known to have been sold for 16 louis d'ors.—It is nearly $7\frac{1}{2}$ inches high by $4\frac{1}{4}$ broad; and has been twice copied. One of the copies is the reverse way: but the other is the same way with the original; and though not so well executed, might without a comparison be mistaken for it.

Lucas, *Richard*, D. D. a learned English divine, was born in 1648, and studied at Oxford; after which he entered into holy orders, and was for some time master of the free school at Abergavenny. Being esteemed an excellent preacher, he became vicar of St Stephen's, Coleman street, in London, and lecturer of St Olave's in Southwark. He was doctor of divinity; aud in 1696 was installed prebendary of Westminster; His sight began to fail him in his youth; and he totally lost it in his middle age. He was greatly esteemed for his piety and learning; and published several works, particularly, 1. Practical Christianity. 2. An Inquiry after Happiness. 3. Several sermons. 4. A Latin translation of the Whole Duty of Man. He died in 1715.

LUCCA, a small republic of Italy on the coast of the Mediterranean, between the territory of Genoa on the west, Modena on the north, and Tuscany on the east. According to Keysler, it is only about 30 miles in circumference, but is exceeding fertile and populous. It contains, besides the city of Lucca, 150 villages. The number of inhabitants is computed at 120,000. The government is lodged in a gonfalonier, whose power is much the same with that of the doges of Venice and Genoa. He is assisted by nine counsellors: but the power of all the ten continues only for two months: during which time they live in the state-palace, and at the public expence. They are chosen out of the great council, which consists of 240 nobles; but even this council is changed by a new election every two years. The revenues of the republic are about 400,000 scudi or crowns; out of which they maintain 500 men by way of regular force, and 70 Swiss as a guard to their acting magistrates. The city of Lucca is situated in a plain, terminating in most delightful eminences, adorned with villas, summer-houses, corn-fields, and plantations of every kind; so that nothing either for use or for pleasure is here wanting. The city, which is about three Italian miles in circumference, has regular well-lined fortifications; and its streets though irregular, are wide, well paved, and full of handsome houses. The number of its inhabitants is computed to be above 40,000; and they carry on large manufactures, especially of silk stuffs. Lucca has a bishop, who enjoys several extraordinary privileges; and its cathedral is Gothic. The city stands in E. Long. 11. 27. N. Lat. 43. 52.

LUCENTI, Lucentia, or *Lucentum*, a town of the Hither Spain, now Alicant, a sea-port of Valencia. W. Long. 32′. Lat. 38°. 37′.

LUCERES, in Roman antiquity, the third in order of the three tribes into which Romulus divided the people; including all foreigners: so called from the *lucus* or grove, where Romulus opened an asylum.

LUCERIA, in *Ancient Geography*, a town of Apulia in Italy; which in Strabo's time still exhibited marks of Diomed's sovereignty in those parts. Ptolemy has *Nuceria*; whether from mistake, or the custom of his time, uncertain. Now *Nocera de Pagani*, in the kingdom of Naples. E. Long. 15. 0. N. Lat. 40. 40.

LUCERIUS, in *Mythology*, a name given to Jupiter, as *Luceria* was given to Juno, as the deities which gave light to the world.

LUCERNE, one of the 13 cantons of Swisserland. It holds the third place among the 13; and is the head of the Catholic cantons. Though less than Zurich, and consequently much less than Berne, it is, however, far more extensive than any of the rest, being 15 or 16 leagues long, and eight broad. The population is estimated at 100,000. Even the mountainous part is not barren, but abundant in wood and pasture, furnishing cattle, hides, cheese, and butter, for exportation. All the north part is fertile in grain, fruit, and hay; supplying sufficient for the consumption of the inhabitants; but as the mountaineers of the little cantons come to their market for corn, the people of Lucerne purchase this commodity from other parts of Swisserland, but especially from Alsace and Suabia.

Lucerne. Suabia. Their manufactures are very inconsiderable; consisting only in a little silk and cotton thread.—The government is oligarchical. The councils are chosen from among 500 citizens only. The great council of 64 members is the nominal sovereign; but in fact the power resides in the senate, or little council of 36, having for their chiefs the two avoyers.—The whole canton professes the Roman Catholic religion. The pope's nuncio, with the title of legate *à latere*, usually resides at Lucerne.—They threw off the Austrian yoke in 1352, and by entering into a perpetual alliance with the three ancient cantons, they gave such weight to the confederacy, as to enable it in 1386 to resist all the efforts of the enemy at the bloody battle of Sempach.

The *town of Lucerne* is situated at the extremity of a most beautiful lake of the same name, where the river Reuss issues from it. The buildings are ancient, and the streets narrow; nor is Lucerne populous in proportion to its extent, the inhabitants being only between 3000 and 4000. Since this is the great passage to Italy by Mount St Gothard, and the merchandise which passes the Alps on mules, and is to be transported by the rivers Reuss, Aar, and Rhine, is all deposited here, it might have a flourishing trade if arts and manufactures were attended to. The Reuss separates the town into two unequal parts, which are connected by three bridges: one wide for carriages; and two narrow covered ones for foot passengers: besides these, there is a fourth over an arm of the lake, to pass to the cathedral. Three of these bridges have old bad paintings of the Dance of Death, and the History of the Bible, and of Swisserland. They make a commodious dry walk for the inhabitants.—Of religious edifices, the principal are the cathedral, or collegiate church of St Leger; the convent of Cordeliers; the college of the Jesuits; the convent of Capuchins, and two convents of nuns. Of the secular buildings, the hotel de ville is the principal. The arsenal is well furnished. The water tower is remarkable only for its position and antiquity; it is said to have been a pharos or lighthouse. What greatly attracts the notice of most strangers is, a plan in relief of part of the cantons of Lucerne, Zug, and Berne, and the whole of Schweitz, Uri, and Underwald, executed by General Pfiffer on a large scale. He has completed about 60 square leagues; the plan is 12 feet long, and nine and a half broad: every mountain is accurately measured; and every object distinctly placed.

The *lake of Lucerne* exhibits greater variety and more picturesque scenery than any other of the Swiss lakes. It is seven leagues long in a right line, and three wide about Kussnacht; but the shape is very irregular. The whole south side is bordered by high mountains; but the north exhibits hills of no great height. The narrow gulf that extends towards the west, is bordered on the west and north-west by Mount Pilat, which is a single mountain rising boldly more than 6000 feet above the lake; and on the south by Mount Burgenberg. Stanz Stadt, belonging to the canton of Underwald, is on this side; and hereabouts the lake is deepest. Kussnacht is on the point of the other gulf, which extends towards the east, and is wider than the former. All the country to the west of these gulfs, and part of it to the north of the latter, belongs to the canton of Lucerne; but that which is to the south and north-east is dependant on the canton of Zug. All the mountains on the left shore of the lake belong to the canton of Underwald; those on the right, partly to the canton of Uri, partly to that of Schweitz, partly to the little republic of Gersaw, but principally to the canton of Lucerne.

Lucia.

LUCERNE, in *Botany*. See MEDICAGO, BOTANY *Index*.—For the culture of this plant, see AGRICULTURE *Index*.

LUCIA, ST, one of the Caribbee islands in the West Indies, about 22 miles long, and 11 broad, the middle of it lying in N. Lat. 39. 14. W. Long. 27. 0. It was first settled by the French in 1650; but was reduced by the English in 1664, who evacuated it in 1666. The French immediately resettled the island, but were again driven away by the Caribbs. As soon as the savages were gone, the former inhabitants returned, but only for a short time; for being afraid of falling a prey to the first privateer that should visit their coasts, they removed either to other French settlements that were stronger, or which they might expect to be better defended. There was then no regular culture or colony at St Lucia; it was only frequented by the inhabitants of Martinico, who came thither to cut wood, and to build canoes, and who had considerable docks on the island. In 1718 it was again settled by the French; but four years after, it was given by the court of London to the duke of Montague, who was sent to take possession of it. This occasioned some disturbance between the two courts; which was settled, however, by an agreement made in 1731, that, till the respective claims should be finally adjusted, the island should be evacuated by both nations, but that both should wood and water there. This precarious agreement furnished an opportunity for private interest to exert itself. The English no longer molested the French in their habitations; but employed them as their assistants in carrying on with richer colonies a smuggling trade, which the subjects of both governments thought equally advantageous to them. This trade has been more or less considerable till the treaty of 1763, when the property of St Lucia was secured to the crown of France. After that time the colony flourished considerably. In the beginning of the year 1772, the number of white people amounted to 2018 souls, men, women, and children; that of the blacks to 663 free men, and 12,795 slaves. The cattle consisted of 928 mules or horses, 2070 head of horned cattle, and 3184 sheep or goats. There were 38 sugar plantations, which occupied 978 pieces of land; 5,595,889 coffee-trees; 1,321,600 cocoa plants; and 367 plots of cotton. There were 706 dwelling places. The annual revenue at that time was about 175,000l. which, according to the Abbé Raynal, must have increased one-eighth yearly for some time. It was taken by the British in 1778; restored to France in 1783. It fell again into the hands of the British in 1794, was evacuated in 1795, and was again retaken in 1796.

The soil of St Lucia is tolerably good, even at the sea side; and is much better the farther one advances into the country. The whole of it is capable of cultivation, except some high and craggy mountains which bear

bear evident marks of old volcanoes. In one deep valley there are ſtill eight or ten ponds, the water of which boils up in a dreadful manner, and retains ſome of its heat at the diſtance of 6000 toiſes from its reſervoirs. The air in the inland parts, like that of all other uninhabited countries, is foul and unwholeſome; but grows leſs noxious as the woods are cleared and the ground laid open. On ſome parts of the ſea coaſt, the air is ſtill more unhealthy, on account of ſome ſmall rivers which ſpring from the foot of the mountains, and have not ſufficient ſlope to waſh down the ſands with which the influx of the ocean ſtops up their mouths, by which means they ſpread themſelves into unwholeſome marſhes on the neighbouring grounds.

LUCIA, *St*, a high and mountainous iſland of Africa, and one of thoſe of Cape Verde, is about nine leagues long, and lies in the latitude of 16° 18′ N. according to the Engliſh geographers; but according to all others, it is a degree farther to the northward. On the eaſt-ſouth-eaſt ſide is a harbour, with a bottom and ſhore of white ſand; but its beſt road is oppoſite to St Vincent's to the ſouth-weſt, where there are at leaſt 20 fathoms of water. On the weſt ſide there is no water: it abounds with goats, ſea and land fowl, tortoiſes, &c. but whether it hath any inhabitants is not certainly known.

LUCIAN, a celebrated Greek author in the firſt century, was born at Samoſata, of obſcure parents, in the reign of the emperor Trajan. He ſtudied law, and practiſed ſome time as an advocate; but growing weary of the wrangling oratory of the bar, he commenced rhetorician. He lived to the time of Marcus Aurelius, who made him regiſter of Alexandria in Egypt; and, according to Suidas, he was at laſt worried by dogs. Lucian was one of the fineſt wits in all antiquity. His Dialogues, and other works, are written in Greek. In theſe he has joined the uſeful to the agreeable, inſtruction to ſatire, and erudition to elegance; and we everywhere meet with that fine and delicate raillery which characterizes the Attic taſte.—Thoſe who cenſure him as an impious ſcoffer at religion, have reaſon on their ſide, if religion conſiſted in the theology of the Pagan poets, or in the extravagant opinions of philoſophers; for he perpetually throws ſuch ridicule on the gods and philoſophers, with their vices, as inſpires hatred and contempt for them; but it cannot be ſaid that he writes anywhere againſt an overruling providence.

LUCIANISTS, or LUCANISTS, a religious ſect, ſo called from Lucianus, or Lucanus, a heretic of the ſecond century, being a diſciple of Marcion, whoſe errors he followed, adding ſome new ones to them. Epiphanius ſays he abandoned Marcion; teaching that people ought not to marry, for fear of enriching the Creator: and yet other authors mention that he held this error in common with Marcion and other Gnoſtics. He denied the immortality of the ſoul; aſſerting it to be material.

There was another ſect of Lucianiſts, who appeared ſome time after the Arians. They taught, that the Father had been a father always, and that he had the name even before he begot the Son; as having in him the power or faculty of generation; and in this manner they accounted for the eternity of the Son.

LUCID INTERVALS, the fits of lunatics or maniacs, wherein the phrenzy leaves them in poſſeſſion of their reaſon.

LUCIFER, according to the poets, was the ſon of Jupiter and Aurora. In aſtronomy, Lucifer is the bright planet Venus, which either goes before the ſun in the morning, for 290 days, and is our morning ſtar; or in the evening follows the ſun, during the ſame time, and then is called *Heſperus* or the evening ſtar.

LUCIFERA, in *Mythology*, a ſurname given to Diana, under which title ſhe was invoked by the Greeks in childbed. She was repreſented as covered with a large veil, interſperſed with ſtars, bearing a creſcent on her head, and holding in her hand a lighted flambeau.

LUCIFERIANS. a religious ſect, who adhered to the ſchiſm of Lucifer, biſhop of Cagliari, in the fourth century, who was baniſhed by the emperor Conſtantius, for having defended the Nicene doctrine concerning the three Perſons in the Godhead.—St Auguſtine ſeems to intimate, that they believed the ſoul, which they conſidered as of a carnal nature, to be tranſmitted to the children from their fathers. Theodoret ſays, that Lucifer was the author of a new error. The Luciferians increaſed mightily in Gaul, Spain, Egypt, &c. The occaſion of the ſchiſm was, that Lucifer would not allow any acts he had done to be aboliſhed. There were but two Luciferian biſhops, but a great number of prieſts and deacons. The Luciferians bore a peculiar averſion to the Arians.

LUCILIUS, CAIUS, a Roman knight, and a Latin poet, was born at Sueſſa in Italy, about 140 B. C. He ſerved under Scipio Africanus in the war with the Numantines; and was in great favour with that celebrated general, and with Lælius. He wrote 30 books of ſatires, in which he laſhed ſeveral perſons of quality very ſharply. Some learned men aſcribe the invention of ſatire to him; but M. Dacier has maintained, with great probability, that Lucilius only gave a better turn to that kind of poetry, and wrote it with more wit and humour than his predeceſſors Ennius and Pacuvius had done. His fragments have been carefully collected by Francis Douza at Leyden in 1599, with notes. But they require ſtill to be better illuſtrated by ſome learned critic.

LUCINA, a goddeſs among the Romans, who preſided over women in labour. Some take her to be Diana, others Juno. She was called *Lucina*, becauſe ſhe brought children to the light; from the Latin word *lux*, "light."

LUCIUS, the ſpecific name of the pike. See ESOX, ICHTHYOLOGY *Index*.

LUCONIA. See MANILLA.

LUCRETIA, the famous Roman matron, wife of Collatinus, and the cauſe of the revolution in Rome from a monarchy to a republic: this lady being raviſhed by Sextus, the eldeſt ſon of Tarquin king of Rome, ſtabbed herſelf, 509 B. C. See the article CHASTITY. The bloody poniard, with her dead body expoſed to the ſenate, was the ſignal of Roman liberty; the expulſion of the Tarquins, and abolition of the regal dignity, was inſtantly reſolved on, and carried into execution. See ROME.

LUCRETIUS, or TITUS LUCRETIUS, CAIUS, one of of the moſt celebrated of the Latin poets, was born of an ancient and noble Roman family, and ſtudied at Athens, where he became one of Epicurus's ſect. He acquired great reputation by his learning and eloquence; but in the flower of his age fell into a frenzy, occaſioned by a philtre given him by his wife, who was diſtractedly fond of him. Lucretius, during the intervals of his madneſs, put Epicurus's doctrines into verſe, and compoſed his ſix books *De Rerum Natura*, which are ſtill extant. It is ſaid that he killed himſelf in a fit of madneſs, in the 54th year before the Chriſtian era, when 51 years old. The moſt correct edition of Lucretius is that of Simon de Coline. The cardinal de Polignac has refuted Lucretius's arguments, in his excellent Latin poem entitled *Anti-Lucretius*. His poem *De Rerum Natura* has been tranſlated into Engliſh by Mr Creech.

LUCRINUS LACUS, in *Ancient Geography*, a lake of Campania, between Baiæ and Puteoli, famous for its oyſters (Horace, Martial, Juvenal); *Lucrinenſes* (Cicero), the people dwelling on it. Now a perfect bay ſince the earthquake in 1538.

LUCULLUS, Lucius Lucinius, a Roman general celebrated for his eloquence, his victories, and his riches. In his youth he made a figure at the bar; and being afterwards made quæſtor in Aſia, and prætor in Africa, governed thoſe provinces with great moderation and juſtice. Scarce was he known as a military man, when he twice beat the fleet of Hamilcar, and gained two great victories over him. His happy genius was greatly improved by ſtudy; for he employed his leiſure in reading the beſt authors on military affairs. Being made conſul with Aurelius Cotta, during the third war with Mithridates king of Pontus, he was ſent againſt this prince: and this expedition was attended with a ſeries of victories, which did him leſs honour than an act of generoſity towards his colleague; who, willing to take advantage of his abſence to ſignalize himſelf by ſome great exploit, haſtened to fight Mithridates; but was defeated and ſhut up in Chalcedonia; where he muſt have periſhed, if Lucullus, ſacrificing his reſentment to the pleaſure of ſaving a Roman citizen, had not flown to his aſſiſtance, and diſengaged him. All Pontus then ſubmitted to Lucullus; who being continued in his government of Aſia, entered the territories of Tigranes, the moſt powerful king in Aſia. That prince marched with a formidable army againſt Lucullus: who defeated him with a handful of men, and killed great numbers of his forces; took Tigranocertes, the capital of his kingdom; and was ready to put an end to the war, when the intrigues of a tribune got him depoſed, and Pompey nominated in his room. Lucullus having brought home prodigious riches, now gave himſelf up to exceſſive luxury; and his table was ſerved with a profuſion till that time unknown. He brought from the Eaſt a great number of books, which he formed into a library, and gave admittance to all men of learning, who frequented it in great numbers. Toward the end of his life, he fell into a kind of madneſs; and Lucullus, his brother was appointed his guardian. He is ſaid to have been the firſt who brought cherries into Europe, having brought the grafts from the kingdom of Pontus.

LUCUS, in general, denotes a wood or grove ſacred to a deity; ſo called *à lucendo*, becauſe a great number of lights were uſually burning in honour of the god (Iſidorus); a practice common with idolaters, as we learn from Scripture: hence Homer's αγλαον αλσος.

LUD, a Britiſh king mentioned in our old chronicles, and ſaid to have reigned about the year of the world 3878. He is reported to have enlarged and walled about *Troynovant*, or New Troy, where he kept his court, and made it his capital. The name of *London* is hence derived from *Lud's town*; and *Ludgate* from his being buried near it: but this is only one among many other derivations of the name of London; which are at leaſt equally probable. See London.

LUDAMAR, a Mooriſh kingdom in the interior part of Africa, the capital of which is ſituated in N. Lat. 15. 0. W. Long. 60 50. which Mr Park conſiders as little ſuperior to a deſert. The Moors of Ludamar ſubſiſt chiefly on the fleſh of their cattle.

The barrenneſs of the country is ſuch, that it furniſhes few materials for manufacture: but the inhabitants contrive to weave a ſtrong cloth, with which their tents are covered; the thread is ſpun by the women from goats hair, and with the hides of their cattle they furniſh ſaddles, bridles, pouches, and other articles of leather. They can alſo convert the native iron procured from the negroes into ſpears, knives, and pots for boiling their food; but they purchaſe their fire-arms and other weapons of a ſimilar nature from the Europeans, in exchange for ſlaves.

Their ideas of female perfection are truly ſingular, ſince a woman, to have the ſmalleſt pretenſions to beauty, muſt be one who requires a ſlave under each arm to ſupport her as ſhe walks; and a perfect beauty, according to Mr Park, is a load for a camel.

The wealth of the Moors chiefly conſiſts in their numerous herds of cattle, yet the majority of the people ſpend their days in a ſtate of idleneſs. The tent of the king is the common place of rendezvous for the indolent, where they appear to enjoy an unlimited liberty of ſpeech; yet in the praiſe of their ſovereign they are wholly unanimous, ſinging ſongs to his honour, which never fail to be filled with the groſſeſt adulation. The king ſometimes eats out of the ſame baſon with the driver of his camels, and during the heat of the day repoſes himſelf upon the ſame bed.

Cavalry conſtitute the chief military ſtrength of Ludamar, which are well mounted, and are very expert in attacking by ſurpriſe. The horſe of every ſoldier is furniſhed by himſelf, as alſo his military implements, conſiſting of a large ſabre, a double-barrelled gun, a red leather bag for holding his balls, and a powder-horn ſlung over his ſhoulder. He has no pay, and his only compenſation ariſes from plunder.

They have no intercourſe with civilized nations, yet they boaſt an advantage over the negroes, as they poſſeſs, though in a very limited degree, the knowledge of letters. They are eſteemed the vaineſt, proudeſt, and moſt bigotted, ferocious, and intolerant of all the nations of the earth, blending in their character the blind ſuperſtition of the negro with the ſavage cruelty and treachery of the Arab. It was with the utmoſt difficulty that Mr Park made his eſcape from this cruel and inhoſpitable people.

LUDI, a term uſed for ſhows and public repreſentations

tations made by the Romans, for the entertainment of the people. See GAMES.

For an account of the particular games of Greece and Rome, as the Isthmian, Nemæan, Olympic, &c. see ISTHMIAN, &c.

LUDIUS, a celebrated painter, lived in the reign of Augustus Cæsar, and excelled in grand compositions. He was the first who painted the fronts of houses in the streets of Rome; which he beautified with great variety of landscapes, and many other different subjects.

LUDLOW, EDMUND, son of Sir Henry Ludlow, was born at Maidenhead, and educated in Trinity college, Oxford. His father opposing the king's interest, Mr Ludlow joined with the same party, and was present at the battle of Edgehill as a volunteer under the earl of Essex. Upon the death of his father, he was chosen knight of the shire for Wilts, and obtained the command of a regiment of horse for the defence of that country. He was one of King Charles I.'s judges: after whose death he was sent by the parliament into Ireland, in quality of lieutenant-general of the horse; which employment he discharged with diligence and success till the death of the lord-deputy Ireton, when he acted for some time as general, though without that title; Cromwell, who knew him to be sincerely in the interest of the commonwealth, always finding out some pretext to hinder the conferring of that character upon him. The last stroke had been given by Ludlow to the Irish rebellion, if the usurpation of Cromwell had not prevented it. Under his power he never acted; and though Cromwell used his utmost efforts, he remained inflexible. After Cromwell's death, he endeavoured to restore the commonwealth; but Charles II. being recalled, he thought proper to conceal himself, and escaped into Switzerland, where he settled. After the revolution, he came over into England, in order to be employed in Ireland against King James: but appearing publicly in London, it gave great offence; and an address was presented by Sir Edward Seymour to King William III. for a proclamation in order to apprehend Colonel Ludlow, attainted for the murder of King Charles I. Upon this he returned to Switzerland, where he died. During his retirement in Switzerland he wrote his Memoirs.

LUDLOW, a town of Shropshire in England, situated at the conflux of the Teme and Corve, 18 miles from Shrewsbury, and 138 from London. The president of the council of the marches, established by Henry VIII. generally kept his courts in it, by which the town was much benefited, these courts not having been abolished till the 1st of William and Mary. Its neighbourhood to Wales makes it a great thoroughfare, and engages many of the Welsh to send their children of both sexes to it for education. It was incorporated by Edward IV. and among other privileges has that of trying and executing criminals within itself. It is one of the neatest towns in England, with walls and seven gates. It is divided into four wards; and is governed by 2 bailiffs, 12 aldermen, 25 common-councilmen, a recorder, a town-clerk, steward, chamberlain, coroner, &c. From the castle on the top of the hill on which the town stands is a most delightful prospect. In an apartment of the outer gatehouse Samuel Butler is said to have written the first part of Hudibras. Of this castle, which was besieged and taken by King Stephen, some of the offices are fallen down, and great part of it turned into a bowling-green; but part of the royal apartments and the sword of state are still left. The walls were at first a mile in compass, and there was a lawn before it for near two miles, of which much is now enclosed. The battlements are very high and thick, and adorned with towers. It has a neat chapel, where are the coats of arms of abundance of Welsh gentry, and over the stable-doors are the arms of Queen Elizabeth, the earls of Pembroke, &c. This castle was a palace of the prince of Wales, in right of his principality. The river Teme has a good bridge over it, several wears across it, and turns a great many mills. Here is a large parochial church, which was formerly collegiate; in the choir whereof is an inscription relating to Prince Arthur, elder brother to King Henry VIII. who died here, and whose bowels were here deposited, though it is said his heart was taken up some time ago in a leaden box. In this choir is a closet, commonly called *God's House*, where the priests used to keep their consecrated utensils; and in the market-place is a conduit, with a long stone cross on it, and a niche wherein is the image of St Laurence, to whom the church was dedicated. On the north side of the town there was a rich priory, whereof there are few ruins to be seen except those of its church. Here are an alms-house for 30 poor people, and two charity-schools where 50 boys and 30 girls are both taught and clothed. It has a market on Monday, and three lesser ones on Wednesday, Friday, and Saturday. Its fairs are on the Tuesday Easter, Whit-Wednesday, August 21. Sept. 28. and Dec. 8. Provisions are very cheap here; and at the annual horse races there is the best of company. The country round is exceedingly pleasant, fruitful, and populous, especially that part called the *Corvesdale*, being the vale on the banks of the river Corve. Ludlow sends two members to parliament.

LUDOLPH, JOB, a very learned writer of the 17th century, was born at Erfurt in Thuringia. He travelled much, and was master of 25 languages, visited libraries, searched after natural curiosities and antiquities everywhere, and conversed with learned men of all nations. He published a History of Ethiopia, and other curious books.

LUDOLPH, *Henry William*, nephew of Job above mentioned, was born at Erfurt in 1655. He came over to England as secretary to M. Lenthe, envoy from the court of Copenhagen to that of London; and being recommended to Prince George of Denmark, was received as his secretary. He enjoyed this office for some years, until he was incapacitated by a violent disorder; when he was discharged with a handsome pension: after he recovered, he travelled into Muscovy, where he was well received by the czar, and where his knowledge made the Muscovite priests suppose him to be a conjurer. On his return to London in 1694, he was cut for the stone; and as soon as his health would permit, in acknowledgement of the civilities he had received in Muscovy, he wrote a grammar of their language, that the natives might learn their own tongue in a regular method. He then travelled into the East, to inform himself of the state of the Christian church in the Levant; the deplorable condition of which induced him, after his return, with the aid of the biſhop of Worceſter, to print an edition of the New Teſtament in the vulgar Greek, to preſent to the Greek church. In 1709, when ſuch numbers of Palatines came over to England, Mr Ludolph was appointed by Queen Anne one of the commiſſioners to manage the charities raiſed for them; and he died early the following year. His collected works were publiſhed in 1712.

LUDWIDGIA, a genus of plants belonging to the tetrandria claſs, and in the natural method ranking under the 17th order, *Calycanthemæ*. See BOTANY *Index*.

LUES, among phyſicians, is in general uſed for a diſeaſe of any kind; but in a more particular ſenſe is reſtrained to contagious and peſtilential diſeaſes; thus the *lues Gallica*, or *venerea*, ſignifies the venereal diſeaſe. See MEDICINE *Index*.

LUFF, the order from the pilot to the ſteerſman to put the helm towards the *lee*-ſide of the ſhip, in order to make the ſhip ſail nearer the direction of the wind. Hence, luff round, or luff a-lee, is the exceſs of this movement, by which it is intended to throw the ſhip's head up in the wind, in order to tack her, &c. A ſhip is accordingly ſaid to ſpring her luff when ſhe yields to the effort of the helm, by ſailing nearer to the line of the wind than ſhe had done before. See alſo *HAULING the Wind*.

LUFF-Tackle, a name given by ſailors to any large tackle that is not deſtined for a particular place, but may be variouſly employed as occaſion requires. It is generally ſomewhat larger than the jigger tackle, although ſmaller than thoſe which ſerve to hoiſt the heavier materials into and out of the veſſel, which latter are the main and fore tackles, the ſtay and quarter tackles, &c.

LUG-SAIL, a ſquare ſail, hoiſted occaſionally on the maſt of a boat or ſmall veſſel upon a yard which hangs nearly at right angles with the maſt. Theſe are more particularly uſed in the barca longas, navigated by the Spaniards in the Mediterranean.

LUGDUNUM, in *Ancient Geography*, the capital of the Seguſiani in Gallia Celtica, ſituated at the conflux of the Arar and Rhodanus, on an eminence, as the Celtic term *dune* ſignifies; built by Manutius Plancus under Auguſtus, while commanding in that part of Gaul; and whither he led a colony. Now *Lyons*, capital of the Lyonnois.

LUGDUNUM Batavorum, in *Ancient Geography*, a town of the Batavi in Gallia Belgica. Now *Leyden* in Holland.

LUGDUNUM Converarum, in *Ancient Geography*, a town of Gaul in Aquitain, at the foot of the Pyrenees. Now *S. Bertrand*, in Gaſcony.

LUGEUS LACUS, in *Ancient Geography*, a lake of Japydia, the weſtmoſt diſtrict of Illyricum, to the ſouth of the Save, and near the head of the Arſia. Now commonly called the *Zirichnitz Lake*, from a ſmall adjoining town. It is locked on every ſide with mountains; from which ſcanty currents run down; the leſs in quantity their waters, becauſe drank up by the earth; till at length they are ſwallowed up in rocky furrows, ſo formed as to reſemble artificial. In theſe the water being ſo redundant as to refuſe receiving any more, they regurgitate, and return the water with extraordinary celerity, which thus ſpreading itſelf, forms a lake, in moſt places 18 cubits deep. Theſe waters afterwards retire with no leſs celerity than they came on, not only through the furrows, but paſs through the whole of the bottom, as through a ſieve; which when perceived by the inhabitants, they directly ſtop up the larger apertures, and thus take large quantities of fiſh: when the lake is dry, they cut down their harveſt on the ſpot where they ſowed, and ſow again before the inundation comes on: and graſs ſhoots ſo quick on it, that it may be cut down in three weeks time, (Lazius, Wernherus).

LUGGERSHALL, a borough of Wiltſhire, 12 miles north of Saliſbury, and 75 north by weſt of London. It is an ancient borough by preſcription, though but a ſmall hamlet, near the foreſt of Chute, in a delightful country; and was the reſidence of ſeveral kings. It had formerly a caſtle. It is governed by a bailiff choſen yearly at the lord of the manor's court-leet. On the neighbouring downs there uſed to be horſe-races.

LUKE, ST, the evangeliſt, and the diſciple of the apoſtles, was originally of Antioch in Syria, and by profeſſion a phyſician. He particularly attached himſelf to St Paul, and was his faithful companion in his travels and labours. He went with him to Troas in Macedonia about the year 51. He wrote his goſpel in Achaia about the year 53; and, ten years after, the acts of the Apoſtles, which contains a hiſtory of 30 years. Of all the inſpired writers of the New Teſtament, his works are written in the moſt elegant Greek. It is believed that St Luke died at Rome, or in Achaia.

Goſpel of St LUKE, a canonical book of the New Teſtament. Some think that it was properly St Paul's Goſpel; and that, when the apoſtle ſpeaks of *his* Goſpel, he means what is called *St Luke's*. Irenæus ſays, that St Luke digeſted into writing what St Paul preached to the Gentiles; and Gregory Nazianzen tells us, that St Luke wrote with the aſſiſtance of St Paul.

St LUKE's the Evangeliſt's Day, a feſtival in the Chriſtian church, obſerved on the 18th of October.

LULA, a town of Swediſh Lapland; ſeated at the mouth of the river Lula, on the weſt ſide of the gulf of Bothnia, 42 miles ſouth-weſt of Tornea. E. Long. 21. 0. N. Lat. 64. 30.

LULA Lapmark, a province of Swediſh Lapland; bounded by that of Tornea on the north, by the Bothnic gulf on the eaſt, by Pithia Lapmark on the ſouth, and Norway on the weſt.

LULLI, JOHN BAPTIST, the moſt celebrated and moſt excellent muſician that has appeared in France ſince the revival of learning, was born at Florence. He was taken to France when very young by a perſon of quality; and he carried the art of playing on the violin to the higheſt perfection. Louis XIV. made him ſuperintendant of muſic. Some time after Perinna having introduced operas into France, and quarrelling with his company, he reſigned his privilege to Lulli. Operas were then carried to the utmoſt perfection by this celebrated muſician, and were attended with continual

nual applause. Lulli every year, after this time, gave a piece of his own composition, till his death, which happened in 1687.

LULLY, RAYMOND, a writer on alchemy, surnamed the *Enlightened Doctor*, was born in the island of Majorca in 1225. He applied himself with indefatigable labour to the study of the Arabian philosophy, to chemistry, physic, and divinity; and acquired great reputation by his works. He at length went to preach the gospel in Africa; and was stoned to death in Mauritania, at the age of 80. He is honoured as a martyr at Majorca, whither his body was carried. He wrote many treatises on all the sciences, in which he shows much study and subtility, but little judgement or solidity. A complete edition of his works has been printed at Mentz.—He ought not to be confounded with Raymond Lully of Terraca, surnamed *Neophyta*, who from being a Jew turned Dominican friar. This last Lully maintained several opinions that were condemned by Pope Gregory XI.

LUMBAGO, a fixed pain in the small of the back. See MEDICINE *Index*.

LUMBARIS, a name given to the arteries and veins which spread over the loins.

LUMBRICAL, a name given to four muscles of the fingers and to as many of the toes.

LUMBRICUS, the WORM, a genus of animals belonging to the order of vermes intestina. See HELMINTHOLOGY *Index*.

LUMELLO, a village in Italy, which gives name to the Lumellin, a small district in the duchy of Milan, lying along the river Po, and of which Mortaria and Valencia are the principal places. It was ceded to the duke of Savoy in 1707, and confirmed by the treaty of Utrecht in 1713. E. Long. 8. 42. N. Lat. 45. 5.

LUMINOUS, an epithet applied to any thing that shines or emits light.

Luminous Emanations have been observed from human bodies, as also from those of brutes. The light arising from currying a horse, or from rubbing a cat's back, are known to most. Instances of a like kind have been known on combing a woman's head. Bartholin gives us an account, which he entitles *mulier splendens*, of a lady in Italy whose body would shine whenever slightly touched with a piece of linen. These effluvia of animal bodies have many properties in common with those produced from glass; such as their being lucid, their snapping, and their not being excited without some degree of friction; and are undoubtedly electrical, as a cat's back has been found strongly electrical when stroaked. See ELECTRICITY and LIGHT.

LUMINOUSNESS OF THE SEA. See LIGHT and SEA.

Luminousness of Putrescent Substances. See LIGHT.

LUMP-FISH. See CYCLOPTERUS, ICHTHYOLOGY *Index*.

LUNA, in *Ancient Geography*, a forest of Germany, at no great distance from the Hercynian; below which were the Boemi: it was therefore in Moravia, near the springs of the Marus, now March, which runs into the Danube over against Carnutum.

LUNA, or *Lunna*, a town of Gallia Celtica. Now *Clugny* in Burgundy.

LUNA, a town and port of Liguria, at the mouth of the Macra. The town was but small, but the port large and beautiful, according to Strabo. Now extinct, and its ruins called *Luna Distrutta*. It was famous for its quarries of white marble, thence called *Lunense*; and for its cheese, remarkable rather for its size than goodness, each being a thousand weight.

LUNA, in *Astronomy*, the moon. See ASTRONOMY, *passim*.

LUNA, in the jargon of the alchemists, signifies *silver*; so called from the supposed influence of the moon thereupon.

Luna Cornea, in *Chemistry*, is a compound of muriatic acid with silver. See SILVER, MURIATE OF, CHEMISTRY *Index*.

LUNACY, a species of madness. See LUNATIC, and MEDICINE *Index*.

LUNACY, in *Law*. See IDIOCY and LUNATIC.

LUNÆ MONS, in *Ancient Geography*, a promontory of Lusitania. Now *Rock of Lisbon*. W. Long. 10. N. Lat. 38. 50.—Another *Lunæ Mons* of Ethiopia, from which the Nile was supposed to take its rise.

Lunæ Portus, a very extensive port, or more truly a bay, of Liguria, between Portus Veneris and Portus Ericis, 20 miles in compass. Now *il Golfo della Spezia*, on the east coast of the territory of Genoa.

LUNAR, something relating to the MOON.

Lunar Month. See MONTH.

Lunar Year, consists of 354 days, or 12 synodical months. See YEAR.

Lunar Dial. See DIALLING.

LUNARE os, in *Anatomy*, is the second bone in the first row of the carpus. It has its name from the Latin, *luna*, "the moon," because one of its sides is in form of a crescent.

LUNARIA, SATIN-FLOWER, or *Moonwort*; a genus of plants belonging to the tetradynamia class; and in the natural method ranking under the 39th order, *Siliquosæ*. See BOTANY *Index*.

LUNARIUM, in *Ancient Geography*, a promontory of the Hither Spain, between Blanda and Bætulo. Commonly called *el Cabo de Palafugel*, in Catalonia, on the Mediterranean; or *Cabo de Tosa*, on the same coast, and in Catalonia, 15 miles from the former, to the west.

LUNATIC, a person affected with that species of madness termed *lunacy*. The word is indeed properly applied to one that hath lucid intervals; sometimes enjoying his senses, and sometimes not; and that frequently supposed to depend on the influence of the moon.

LUNATIC, in *Law*. Under the general term of *non compos mentis* (which Sir Edward Coke says is the most legal name), are comprised not only lunatics, but persons under frenzies, or who lose their intellects by disease; those that *grow* deaf, dumb, and blind, not being *born* so; or such, in short, as are judged by the court of chancery incapable of conducting their own affairs. To these also, as well as idiots, the king is guardian, but to a very different purpose. For the law always imagines, that these accidental misfortunes may be removed; and therefore only constitutes the crown a trustee for the unfortunate persons, to protect their property, and to account to them for all profits received, if they recover, or after their decease to their representatives.

tatives. And therefore it is declared by the ſtatute 17 Edw. II. c. 10. that the king ſhall provide for the cuſtody and ſuſtentation of lunatics, and preſerve their lands, and the profits of them, for their uſe when they come to their right mind; and the king ſhall take nothing to his own uſe: and if the parties die in ſuch eſtate, the reſidue ſhall be diſtributed for their ſouls by the advice of the ordinary, and of courſe (by the ſubſequent amendments of the law of adminiſtrations) ſhall now go to their executors or adminiſtrators.

On the firſt attack of lunacy, or other occaſional inſanity, when there may be hopes of a ſpeedy reſtitution of reaſon, it is uſual to confine the unhappy objects in private cuſtody under the direction of their neareſt friends and relations; and the legiſlature, to prevent all abuſes incident to ſuch private cuſtody, hath thought proper to interpoſe its authority, by 14 Geo. III. c. 49. for regulating private mad-houſes. But when the diſorder is grown permanent, and the circumſtances of the party will bear ſuch additional expence, it is thought proper to apply to the royal authority to warrant a laſting confinement.

The method of proving a perſon *non compos* is very ſimilar to that of proving him an idiot. The lord chancellor, to whom, by ſpecial authority from the king, the cuſtody of idiots and lunatics is intruſted, upon petition or information, grants a commiſſion in nature of the writ *de idiota inquirendo*, to inquire into the party's ſtate of mind; and if he be found *non compos*, he uſually commits the care of his perſon, with a ſuitable allowance for his maintenance, to ſome friend, who is then called his committee. However, to prevent ſiniſter practices, the next heir is ſeldom permitted to be of this committee of the perſon; becauſe it is his intereſt that the party ſhould die. But it hath been ſaid there lies not the ſame objection againſt his next of kin, provided he be not his heir; for it is his intereſt to preſerve the lunatic's life, in order to increaſe the perſonal eſtate by ſavings, which he or his family may hereafter be entitled to enjoy. The heir is generally made the manager or committee of the eſtate, it being clearly his intereſt by good management to keep it in condition: accountable, however, to the court of chancery, and to the *non compos* himſelf, if he recovers; or otherwiſe, to his adminiſtrators. See Idiocy.

LUNATION, the period or ſpace of time between one new moon and another; alſo called *ſynodical month*. See Cycle and Epact.

LUNDEN, or Lund, a conſiderable town of Sweden, in Gothland; and capital of the territory of Schonen, with an archbiſhop's ſee and an univerſity. It was ceded to the Swedes by the Danes in 1658. E. Long. 13. 25. N. Lat. 55. 40.

LUNDY island, ſituated 50 miles in the ſea, off the north-weſt coaſt of Devonſhire, is five miles long and two broad, but ſo encompaſſed with inacceſſible rocks, that it has but one entrance to it, ſo narrow that two men can ſcarcely go abreaſt. It is reckoned in the hundred of Brandon. It had once both a fort and a chapel. The ſouth part of it is indifferent good ſoil, but the north part of it is barren, and has a high pyramidal rock called the *Conſtable*. Here are horſes, kine, hogs, and goats, with great ſtore of ſheep and rabbits; but the chief commodity is fowl, with which it abounds much, their eggs being very thick on the ground at their ſeaſon of breeding. No venomous creature will live in this iſland. In the reign of Henry VIII. one William Moriſco, who had conſpired to murder him at Woodſtock, fled to this iſland, which he fortified, turned pirate, and did much damage to this coaſt; but was taken by ſurpriſe at length, with 16 of his accomplices, and put to death.

LUNE, Lunula, in *Geometry*, a plane in form of a creſcent or half-moon, terminated by the circumference of two circles, that interſect each other within.

LUNENBURG, or Lunenburg *Zell*, a principality of Germany, bounded to the ſouth by that of Calenberg, the dioceſe of Hildeſheim, and the duchy of Brunſwic; to the north, by the duchy of Lauenburg and the Elbe, by the laſt of which it is ſeparated from the territory of the imperial city of Hamburgh; to the eaſt, by the duchy of Brunſwic, the Alte Mark, and the duchy of Mecklenburg; and to the weſt, by the duchies of Bremen and Verden, the county of Hoya, and the principality of Calenberg. The ſoil, except along the Elbe, Aller, and Jetz, is either ſand, heath, or moor. In the more fruitful parts of it are produced wheat, rye, barley, oats, peaſe, buck-wheat, flax, hemp, hops, pulſe, oak, beech, firs, pines, birch, and alder, together with black cattle and horſes. The heaths abound with bees and honey, and a ſmall kind of ſheep whoſe wool is long and coarſe. Lunenburg is well furniſhed with ſalt ſprings and limeſtone, and the foreſt of Gorde with veniſon. The rivers Elbe, Ilmenau and Aller, are navigable; and conſequently very advantageous to the country, independent of the fiſh which they yield. The general diets of this principality are convened by the ſovereign twice a-year, and held at Zell. They conſiſt of the deputies of the nobility and the towns of Lunenburg, Uelzen, and Zell, who have the nomination of the members of the high colleges, and other officers, jointly with the ſovereign. There are near 200 Lutheran churches in the country, under two general and 15 ſubordinate ſuperintendants, ſeveral grammar-ſchools, two Calviniſt churches at Zell, and an academy of exerciſes at Lunenburg. The manufactures are chiefly linen cloth, cottons, ribbons, ſtockings, hats, ſtarch, bleached wax, refined ſugar, gold and ſilver wires, all kinds of wooden wares, barges, boats, and ſhips. The exports of theſe to Hamburgh, Lubec, and Altona, are conſiderable. The neighbourhood of theſe cities, with the facility of conveying goods and merchandiſe to them and other places, either by land or water, is very advantageous to this country, and contributes greatly to its ſubſiſtence. On account of this principality, the king of Great Britain has a ſeat and voice both in the college of the princes of the empire and of the circle of Lower Saxony. Its quota in the matricula is 20 horſe and 120 foot, or 720 florins in lieu of them. The revenues of the principality ariſe chiefly from the demeſnes, tolls on the Elbe, contributions, duties on cattle, beer, wine, brandy, and other commodities, which all together muſt be very conſiderable, ſome bailiwics alone yielding upwards of 20,000 rix-dollars.

Lunenburg, the capital of the principality of the ſame name, is a pretty large town of Germany, on the river Elmen, or the Ilmenau, which is navigable from the town to the Elbe, at the diſtance of 13 miles. It is 27 miles from Hamburgh, 43 from Zell, 65 from Brunſwic, Lunenburg, Lunense Marmor.

Brunswic, 76 from Bremen, 68 from Hanover; and stands in E. Long. 10. 40. N. Lat. 53. 28. Its inhabitants are reckoned at between 8000 and 9000. Formerly this town was one of the Hanse, and an imperial city. Some derive its name from *Lina*, the ancient name of the Ilmenau; others from *Luna*, the moon, an image of which is said to have been worshipped by the inhabitants in the times of Paganism. Here were anciently several convents, viz. one of Minims, another of Premonstratensians, another of Benedictines, and a fourth of Minorites. Out of the revenues of the Benedictine monastery was founded an academy for the martial exercises, where young gentlemen of the principality of Lunenburg are maintained gratis, and taught French, fencing, riding, and dancing; but foreigners are educated at a certain fixed price. A Latin school was also founded, consisting of four classes, and well endowed out of these revenues. The superintendancy and management of these, and the estates appropriated to their maintenance, belongs to the landschaft director, and the aufreiter, who are both chosen from among the Lunenburg nobility. The first came in place of the Popish abbot, and as such is head of the states of the principality, and president of the provincial college. He has the title of *excellency*; and in public instruments styles himself, *by the grace of God landschaft director*, and *lord of the mansion of St Michael in Lunenburg*. The chief public edifices are three parish-churches, the ducal palace, three hospitals, the town-house, the salt-magazine, the anatomical theatre, the academy; the conventual church of St Michael, in which lie interred the ancient dukes, and in which is the famous table eight feet long, and four wide, plated over with chased gold, with a rim embellished with precious stones, of an immense value, which was taken from the Saracens by the emperor Otho, and presented to this church: but in 1698, a gang of thieves stripped it of 200 rubies and emeralds, together with a large diamond, and most of the gold, so that at present but a small part of it remains. Here are some very rich salt springs. Formerly, when there was a greater demand for the salt, upwards of 120,000 tons have been annually boiled here, and sold off; but since the commencement of the present century, the salt trade hath declined greatly. A fifth of the salt made here belongs to the king, but is farmed out. It is said to excel all the other salt made in Germany. This town is well fortified; and has a garrison, which is lodged in barracks. In the neighbourhoood is a good limestone quarry; and along the Ilmenau are warehouses, in which are lodged goods brought from all parts of Germany, to be forwarded by the Ilmenau to Hamburgh, or by the Asche to Lubec, from whence other goods are brought back the same way. The town itself carries on a considerable traffic in wax, honey, wool, flax, linen, salt, lime, and beer.

LUNENSE MARMOR, in the natural history of the ancients, the name of that species of white marble now known among us by the name of the *Carrara marble*, and distinguished from the statuary kind by its greater hardness and less splendour. It was ever greatly esteemed in building and ornamental works, and is so still. It is of a very close and fine texture, of a very pure white, and much more transparent than any other of the white marbles. It has always been found in great quantities in Italy, and is so to this day. See LUNA.

Lunette, Lungs.

LUNETTE, in *Fortification*, an enveloped counterguard, or elevation of earth, made beyond the second ditch, opposite to the places of arms; differing from the ravelins only in their situation. *Lunettes* are usually made in ditches full of water, and serve to the same purpose as fausssebrayes, to dispute the passage of the ditch. See FORTIFICATION.

LUNETTE, in the manege, is a half horse-shoe, or such a shoe as wants the sponge, i. e. that part of the branch which runs towards the quarters of the foot.

LUNETTE is also the name of two small pieces of felt, made round and hollow, to clap upon the eyes of a vicious horse that is apt to bite, and strike with his fore feet, or that will not suffer his rider to mount him.

LUNGS, in *Anatomy*, a part of the human body, serving for respiration. See ANATOMY, N° 117.

In the *Journal de Médicine* for June 1789 is a description of an

Instrument for Inflating the LUNGS, invented by M. Gorcy, physician to the military hospital at Neufbrisack, which appears to be extremely well adapted to the purpose, whilst it may be used with the greatest ease and facility.

This instrument, which the inventor styles *apodopic*, that is, "restorer of respiration," consists of a double pair of bellows, BCLM, fig. 1. the two different parts of which have no communication with each other. In the lower side BM, is an aperture A for a valve constructed on the principles of those of Mr Nairne's air-pump. It consists of a rim of copper, closed at one end by a plate of the same metal, in which plate are seven small holes placed at equal distances. This plate is covered with pieces of silk coated with elastic gum, in which are six transverse incisions of two or three lines in length. Each incision is so made as to be situated between two of the holes, and at an equal distance from each: *see* D, fig. 2. The silk must be made very secure, by a thread passing several times round the rim. It is obvious, that a stream of air applied to that side of the plate which is opposite the silk, will pass through the holes, and, lifting up the silk, escape through the incisions. On the contrary, a stream of air applied to the other side will press the silk upon the plate, and thus close the holes, so that it will be impossible for it to pass through them. This valve opens internally, so as to admit the air from without. At B is another valve, on the same construction, but opening in a contrary direction, thus permitting the air to escape out of the lower part into the tube EF, but preventing its entrance. At C is another valve, opening internally to admit the air from the tube EF; and at D there is a fourth, opening externally to discharge the air from the upper part.

Plate CCXCVIII.

The flexible tube EF, screwed on at the end CB, being introduced into one of the nostrils, whilst the mouth and the other nostril are closed by an assistant, if we separate the two handles LM, which were close together at the introduction of the tube, it is evident, that the air in the lungs will rush into the upper part through the valve C, whilst the external air will fill the lower part through the valve A: the two handles being

being again brought into contact, the atmospheric air will be forced into the lungs through the valve B, and at the same time the air in the upper part will be discharged at the valve D. Thus by the alternate play of the double bellows, the lungs will be alternately filled and emptied as in respiration. In using the instrument care should be taken not to be too violent; as the more perfectly the natural motion of respiration is imitated, the better.

To prevent any substances from without injuring the valves AD, fig. 1. the rim is made with a screw, B, fig. 3. in order to receive a cap AA, fig. 3. full of small holes. This screw has also another use. If air or oxygen gas be preferred, a bladder filled with it, fig. 4. may, by means of the screw A, be fastened to the valve A, fig. 1.; and, to prevent waste, as this air may serve several times, a flexible tube may be screwed on the valve D, fig. 1. communicating with the bladder by means of the opening *d*, fig. 4.: thus it may be employed as often as the operator thinks proper.

There is a handle K to the partition in the middle, in order that, if it be at any time necessary to use either of the divisions alone, the other may be confined from acting. *c*, *b*, fig. 5. represent the two valves to be applied at the end of the instrument C, B, fig. 1.; and fig. 6. is a section of the end CB, showing the valves in their proper places.

It is proper to add, that the capacity of the instrument should be proportioned to the quantity of air received into the lungs in inspiration, which Dr Goodwyn has ascertained to be twelve cubical inches or somewhat more. Each division of the instrument, therefore, should be capable of containing that quantity.

Lung-Wort. See PULMONARIA, BOTANY *Index.*

LUNISOLAR YEAR, in *Chronology*, the space of 532 common years; found by multiplying the cycle of the sun by that of the moon.

LUNULA. See LUNE.

LUPERCALIA, feasts instituted in ancient Rome, in honour of the god Pan. The word comes from *Lupercal*, the name of a place under the Palatine mountain, where the sacrifices were performed.

The Lupercalia were celebrated on the 15th of the kalends of March, that is, on the 15th of February, or, as Ovid observes, on the third day after the ides. They are supposed to have been established by Evander.

On the morning of this feast, the Luperci, or priests of Pan, ran naked through the streets of Rome, striking the married women they met on the hands and belly with a thong or strap of goats leather, which was held an omen promising them fecundity and happy deliveries. See LUPERCI.

This feast was abolished in the time of Augustus; but afterwards restored, and continued to the time of the emperor Anastasius.—Baronius says it was abolished by the pope in 496.

LUPERCI, a name given to the priests of the god Pan. See LUPERCALIA.

The *luperci* were the most ancient order of priests in Rome; they were divided into two colleges or companies, the one called *Fabii* and the other *Quintilii*. To these Cæsar added a third, which he called *Julii*.

LUPINUS, LUPINE; a genus of plants belonging to the diadelphia class; and in the natural method ranking under the 32d order, *Papilionaceæ*. See BOTANY *Index.*

LUPULUS, the HOP plant. See HUMULUS, BOTANY *Index.*

LUPUS, the WOLF. See CANIS, MAMMALIA *Index.*

Lupus-Marinus, the *Sea-wolf*, a fish. See ANARRHICAS, ICHTHYOLOGY *Index.*

LUPUS, in *Astronomy.* See ASTRONOMY *Index.*

LURCHER, a kind of hunting-dog, much like a mongrel greyhound with pricked years, a shagged coat, and generally of a yellowish white colour: they are very swift runners, so that if they get between the burrows and the conies they seldom miss; and this is their common practice in hunting: yet they use other subtilties, as the tumbler does, some of them bringing in their game, and those are the best. It is also observable, that a lurcher will run down a hare at stretch.

LURE, in falconry, a device of leather, in the shape of two wings, stuck with feathers, and baited with a piece of flesh, to call back a hawk when at considerable distance.

LURGAN, a town in the county of Armagh and province of Ulster in Ireland, 67 miles from Dublin. It is a flourishing town, agreeably situated in the midst of a much improved country; and the inhabitants are extensively engaged in the linen manufacture. It stands on a gentle eminence, about two miles from Lough-Neagh, of which it commands a most beautiful and extensive prospect. N. Lat. 54. 35. W. Long. 6. 31.

LURGAN-GREEN, a town of Ireland, in the county of Louth and province of Leinster, 37 miles from Dublin; a mile beyond which is a handsome seat of the earl of Charlemont.

LURIDÆ, the name of the 28th order in Linnæus's fragments of a natural method. See BOTANY, Natural Orders.

LUSATIA, a marquisate of Germany, in Upper Saxony; bounded to the east by Silesia, to the west by Misnia, to the south by Bohemia, and to the north by the marquisate of Brandenburgh. Till towards the middle of the 15th century, the Upper Lusatia was called the *Mark*, i. e. *the marquisate or the land of Budiszin and Gorlitz;* and the Lower only *Lusatia*, which it is said, in the Sclavonic, signifies "a woody or marshy country." The air of the Upper Lusatia, which is hilly or mountainous, is better than that of the Lower, a great part of which is moorish and boggy. Both abound in wood, especially the Lower, and turf for fuel. The heathy and mountainous tracts are generally barren; but the lower champaign and marsh lands are tolerably fertile, producing pasture, wheat, rye, oats, barley, buck-wheat, pease, lentils, beans, and millet; together with flax, hops, tobacco, some white and red wine, and what is called *manna.* Of several of these articles, however, considerable quantities are imported. In this country are found also quarries of stone, medicinal springs, bastard diamonds, agates, and jaspers, earths and clays for tobacco-pipes and all sorts of earthen ware, alum, good iron stone, vitriolic and copper water; nor is it destitute of cattle, fish, and venison. The rivers Spree, the Schwarze or Black Elster, and the Pulznitz, have their

their ſources in the Luſatias, which are alſo watered by the Neiſſe and Queis. The ancient inhabitants of this country were the Saxons, who were ſucceeded by the Vandals, and theſe by the Sober-Wends, a Sclavonian people. The preſent inhabitants, the deſcendants of the Wends, have an odd dreſs; and the language is ſo inarticulate and guttural, that it hath been ſaid, it might be pronounced without lips, teeth, or tongue; but the towns are almoſt wholly peopled by Germans.

In the Upper Luſatia are ſix towns which appear at the land-diets, 16 ſmaller country towns, and four market towns. In the Lower are four diet towns, 13 country towns, and two market ones. Both marquiſates were formerly ſubject either to the kings of Bohemia, the archdukes of Auſtria, or electors of Brandenburgh; but, in 1636, both were abſolutely ceded to the elector of Saxony, in lieu of the 72 tons of gold which he expended in aſſiſting the emperor Ferdinand II. againſt the Bohemians.

Chriſtianity was firſt planted in Luſatia in the ſeventh century; but it was ſeveral centuries after that before Popery was fully eſtabliſhed. In the 11th century many cloiſters were erected in the country; but at the Reformation ſuch numbers embraced Lutheraniſm, that it became the predominant religion, and ſtill continues, though there are ſtill ſeveral Roman Catholic foundations, churches, market-towns, and villages. The enthuſiaſtic ſect of Hernhuters poſſeſſes a great influence and eſteem here. There are conſiderable manufactures of woollen and linen ſtuffs in the Luſatias, eſpecially the Upper. At Budiſſen, and in the adjacent country, prodigious quantities of ſtockings, ſpatterdaſhes, caps, and gloves are made. The linen manufactures alſo flouriſh here, chiefly in the Upper Luſatia, where all ſorts of linen are made, printed, and dyed. Excluſive of theſe, there are conſiderable manufactures of hats, leather, paper, gunpowder, iron, glaſs, bleached wax, &c. Though the demand and exportation of theſe commodities, particularly linens and woollens, is not ſo great as formerly, yet it is ſtill conſiderable, and more than overbalances their importations in wool, yarn, ſilk, wines, ſpices, corn, freſh and baked fruits, garden ſtuff, and hops. Diſputes of many years ſtanding have ſubſiſted between the country artificers and linen manufacturers on the one ſide, and the diet towns on the other; the latter unjuſtly ſeeking to exclude the former from any ſhare in the linen trade. The natives of this country are ſaid to have quick natural parts, but to be ſordidly penurious. We are told they obſerve the Saxon laws much better than they did the Bohemian. Learning hath been much eſteemed and encouraged in both marquiſates ſince the Reformation. The ſchools in the ſix diet towns of Upper Luſatia, particularly at Gorlitz, Budiſſen, and Zittau, greatly diſtinguiſh themſelves, having handſome ſtipends. In Lower Luſatia alſo are ſome good ſchools, with ſtipends for the maintenance of ſtudents. Printing is ſaid to be much followed, and brought to great perfection in this country.

In Upper Luſatia, the ſtates conſiſt, 1ſt, of thoſe called *ſtate-lords;* 2dly, of the prelates; 3dly, of the gentry and commonalty, under which are comprehended the counts, barons, nobles, and burgeſſes, poſſeſſors of fees and fief-eſtates; and, 4thly, of the repreſentatives of the ſix principal towns. Without the conſent of theſe ſtates no taxes can be impoſed, nor any thing of importance, that regards the public, tranſacted. The diets are ordinary or extraordinary. The ordinary meet once in three years, and the extraordinary when ſummoned by the ſovereign upon particular emergencies. As to eccleſiaſtical matters, the dean of Budiſſen and his conſiſtory exerciſe all manner of epiſcopal juriſdiction; and among the Proteſtants, the juriſdiction belongs either to the ſuperior, the upper-office, or the patrons. The revenues ariſing to the ſuperior or ſovereign, from Upper Luſatia, conſiſt partly of the ſubſidies granted by the ſtates, among which, at preſent, are reckoned capitation and eſtate-money; and partly of the beer-tax, exciſe, tolls, &c. —Upper Luſatia is divided into two great circles, viz. thoſe of Budiſſen and Gorlitz, which are again divided into leſſer circles.

The land ſtates of Lower Luſatia conſiſt, like thoſe of the Upper, of prelates, lords, and knights, and the repreſentatives of the ſtate towns, which are Luckau, Gubben-Lubben, and Kalau. Two land diets are yearly held at Lubben, called *voluntary-diets;* but when the ſuperior cauſes the ſtates to be ſummoned together at his diſcretion, and propoſitions to be laid before them, by commiſſaries deputed for that purpoſe, ſuch convention is called a *great land diet.* The marquiſate is divided into five circles, each of which holds a circle aſſembly in its circle town. The chief officers appointed either by the ſuperior or the ſtates are, the preſident of the upper office, the land captain, and the land judge. The principal tribunals are, the land court, and the upper office, to which lie appeals from the inferior judicatories. There are alſo officers for the ſeveral circles. Spiritual matters belong here to a conſiſtory, erected in 1668. The ordinary taxes are paid into the cheſt of the circle; and from thence conſigned to the general cheſt, of which the upper tax-receiver is ſuperintendant. By him an annual account of the receipts is made out, which is examined and paſſed by the deputies of the ſtates.

LUSITANIA, in *Ancient Geography*, one of the diviſions of Spain, extending to the north of the Tagus, quite to the ſea of Cantabria, at leaſt to the Promontorium Celticum. But Auguſtus, by a new regulation, made the Anas its boundary to the ſouth, the Durius to the north; and thus conſtituting only a part of the modern Portugal. *Luſitani* the people, (Diodorus, Stephanus).

LUSTRAL, an epithet given by the ancients to the water uſed in their ceremonies to ſprinkle and purify the people. From them the Romaniſts have borrowed the holy water uſed in their churches.

Lustral Day (Dies Luſtricus), that whereon the luſtrations were performed for a child, and its name given; which was uſually the ninth day from the birth of a boy, and the eighth from that of girl. Though others performed the ceremony on the laſt day of that week wherein the child was born, and others on the fifth day from its birth.

Over this feaſt-day the goddeſs Nundina was ſuppoſed to preſide; the midwives, nurſes, and domeſtics handed the child backwards and forwards, around a fire burning on the altars of the gods, after which they ſprinkled it with water; hence this feaſt had the name of *amphidromia*. The old women mixed saliva and dust with the water. The whole ended with a sumptuous entertainment. The parents received gifts from their friends on this occasion. If the child was a male, their door was decked with an olive garland; if a female, with wool, denoting the work about which women were to be employed.

LUSTRATION, in *Antiquity*, sacrifices or ceremonies by which the ancients purified their cities, fields, armies, or people, defiled by any crime or impurity. Some of these lustrations were public, others private. There were three species or manners of performing lustration, viz. by fire and sulphur, by water, and by air; which last was done by fanning and agitating the air round the thing to be purified. Some of these lustrations were necessary, i. e. could not be dispensed with; as lustrations of houses in time of a plague, or upon the death of any person: others again were done out of choice, and at pleasure. The public lustrations at Rome were celebrated every fifth year; in which they led a victim thrice round the place to be purified, and in the mean time burnt a great quantity of perfumes. Their country lustrations, which they called *ambarvalia*, were celebrated before they began to reap their corn: in those of the armies, which they called *armilustria*, some chosen soldiers, crowned with laurel, led the victims, which were a cow, a sheep, and a bull, thrice round the army ranged in battle-array in the field of Mars, to which deity the victims were afterwards sacrificed, after pouring out many imprecations upon the enemies of the Romans. The lustrations of their flocks were performed in this manner: the shepherd sprinkled them with pure water, and thrice surrounded his sheepfold with a composition of savin, laurel, and brimstone set on fire; and afterwards sacrificed to the goddess Pales an offering of milk boiled, wine, a cake, and millet. As for private houses, they were lustrated with water, a fumigation of laurel, juniper, olive tree, savin, and such like; and the victim commonly was a pig. Lustrations made for particular persons were commonly called *expiations*, and the victims *piacula*. There was also a kind of lustration used for infants, by which they were purified, girls the third, and boys the ninth, day after their birth; which ceremony was performed with pure water and spittle. See the article AMBARVALIA.—In their lustratory sacrifices, the Athenians sacrificed two men, one for the men of their city, and the other for the women. Divers of these expiations were austere: some fasted; others abstained from all sensual pleasures; and some, as the priests of Cybele, castrated themselves. The postures of the penitents were different according to the different sacrifices. The priests changed their habits according to the ceremony to be performed; white, purple, and black, were the most usual colours. They cast into the river, or at least out of the city, the animals or other things that had served for a lustration or sacrifice of atonement; and thought themselves threatened with some great misfortune when by chance they trod upon them. Part of these ceremonies were abolished by the emperor Constantine and his successors: the rest subsisted till the Gothic kings were masters of Rome; under whom they expired, excepting what the popes thought proper to adopt and bring into the church.

For the lustration, or rather expiation, of the ancient Jews, see EXPIATION.

LUSTRE, the gloss or brightness appearing on any thing, particularly on manufactures of silk, wool, or stuff. It is likewise used to denote the composition or manner of giving that gloss.

The lustre of silks is given them by washing in soap, then clear water, and dipping them in alum water cold. To give stuffs a beautiful lustre: For every eight pounds of stuff allow a quarter of a pound of linseed; boil it half an hour, and then strain it through a cloth, and let it stand till it is turned almost to a jelly: afterwards put an ounce and a half of gum to dissolve 24 hours; then mix the liquor, and put the cloth into this mixture; take it out, dry it in the shade, and press it. If once doing is not sufficient, repeat the operation. Curriers give a lustre to black leather first with juice of barberries, then with gum-arabic, ale, vinegar, and Flanders glue, boiled together. For coloured leather, they use the white of an egg beaten in water. Moroccoes have their lustre from juice of barberries, and lemon or orange. For hats, the lustre is frequently given with common water: sometimes a little black dye is added: the same lustre serves for furs, except that for very black furs they sometimes prepare a lustre of galls, copperas, Roman alum, ox's marrow, and other ingredients.

LUSTRE, an appellation given to a branched candlestick, when made of glass. See BRANCH and JESSE.

LUSTRINGS. A company was incorporated for making, dressing, and lustrating alamodes and lustrings in England, who were to have the sole benefit thereof, by stat. 4 and 5 William and Mary. And no foreign silks known by the name of *lustrings* or alamodes are to be imported but at the port of London, &c. Stat. 9 and 10 William III. c. 43. See SILK.

LUSTRUM, in Roman antiquity, a general muster and review of all the citizens and their goods, which was performed by the censors every fifth year, who afterwards made a solemn lustration. See the article LUSTRATION.

This custom was first instituted by Servius Tullius, about 180 years after the foundation of Rome. In course of time the lustra were not celebrated so often; for we find the fifth lustrum celebrated at Rome only in the 574th year of that city.

LUTE, or LUTING, among chemists, a mixed, tenacious, ductile substance, which grows solid by drying, and, being applied to the juncture of vessels, stops them up so as to prevent the air from getting either in or out.

LUTE, is also a musical instrument with strings.—The lute consists of four parts, viz. the table, the body or belly, which has nine or ten sides: the neck, which has nine or ten stops or divisions, marked with strings: and the head or cross, where the screws for raising and lowering the strings to a proper pitch of tone are fixed. In the middle of the table there is a rose or passage for the sound; there is also a bridge that the strings are fastened to, and a piece of ivory between the head and the neck to which the other extremities of the strings are fitted. In playing, the strings are struck with the right hand, and with the left the stops are pressed. The lutes of Bologna are esteemed the best on account of the wood, which is said to have an uncommon disposition for producing a sweet sound.

Lutetia, Luther.

LUTETIA PARISIORUM, in *Ancient Geography*, a town of the Parisii, in Gallia Celtica, situated in an island in the Sequana or Seine. It received its name, as some suppose, from the quantity of clay, *lutum*, which is in its neighbourhood. J. Cæsar fortified and embellished it, from which circumstance some authors call it *Julii Civitas*. Julian the apostate resided there for some time. It is now PARIS, the capital of France; so called from its name *Paryis* in the lower age.

LUTHER, MARTIN, the celebrated author of the Reformation, was a native of Eisleben in Saxony, and born in 1483. Though his parents were poor, he received a learned education; during the progress of which, he gave many indications of uncommon vigour and acuteness of genius. As his mind was naturally susceptible of serious impressions, and tinctured with somewhat of that religious melancholy which delights in the solitude and devotion of a monastic life, he retired into a convent of Augustinian friars; where he acquired great reputation, not only for piety, but for love of knowledge and unwearied application to study. The cause of this retirement is said to have been, that he was once struck by lightning, and his companion killed by his side by the same flash. He had been taught the scholastic philosophy which was in vogue in those days, and made considerable progress in it: but happening to find a copy of the Bible which lay neglected in the library of his monastery, he applied himself to the study of it with such eagerness and assiduity, as quite astonished the monks; and increased his reputation for sanctity so much, that he was chosen professor first of philosophy, and afterwards of theology, at Wittemberg on the Elbe, where Frederic elector of Saxony had founded an university.

While Luther continued to enjoy the highest reputation for sanctity and learning, Tetzel, a Dominican friar, came to Wittemberg in order to publish indulgences. Luther beheld his success with great concern; and having first inveighed against indulgences from the pulpit, he afterwards published 95 theses, containing his sentiments on that subject. These he proposed, not as points fully established, but as subjects of inquiry and disputation. He appointed a day on which the learned were invited to impugn them either in person or by writing; and to the whole he subjoined solemn protestations of his high respect for the apostolic see, and of his implicit submission to its authority. No opponent appeared at the time prefixed; the theses spread over Germany with astonishing rapidity, and were read with the greatest eagerness.

Though Luther met with no opposition for some little time after he began to publish his new doctrines, it was not long before many zealous champions arose to defend those opinions with which the wealth and power of the clergy were so strictly connected. Their cause, however, was by no means promoted by these endeavours; the people began to call in question even the authority of the canon law and of the pope himself.—The court of Rome at first despised these new doctrines and disputes; but at last the attention of the pope being raised by the great success of the reformer, and the complaints of his adversaries, Luther was summoned in the month of July 1518, to appear at Rome, within 60 days, before the auditor of the chamber. One of Luther's adversaries, named Prierias, who had written against him, was appointed to examine his doctrines, and to decide concerning them. The pope wrote at the same time to the elector of Saxony, beseeching him not to protect a man whose heretical and profane tenets were so shocking to pious ears; and enjoined the provincial of the Augustinians to check by his authority the rashness of an arrogant monk, which brought disgrace upon their order, and gave offence and disturbance to the whole church.

From these letters, and the appointment of his open enemy Prierias to be his judge, Luther easily saw what sentence he might expect at Rome; and therefore discovered the utmost solicitude to have his cause tried in Germany, and before a less suspected tribunal. He wrote a submissive letter to the pope, in which he promised an unreserved obedience to his will, for as yet he entertained no doubt of the divine original of the pope's authority; and by the intercession of the other professors, Cajetan the pope's legate in Germany was appointed to hear and determine the cause. Luther appeared before him without hesitation: but Cajetan thought it below his dignity to dispute the point with a person so much his inferior in rank; and therefore required him by virtue of the apostolic powers with which he was clothed, to retract the errors which he had uttered with regard to indulgences and the nature of faith, and to abstain for the future from the publication of new and dangerous opinions; and at the last forbade him to appear in his presence, unless he proposed to comply with what had been required of him.

This haughty and violent manner of proceeding, together with some other circumstances, gave Luther's friends such strong reasons to suspect that even the imperial safe-conduct would not be able to protect him from the legate's power and resentment, that they prevailed on him secretly to withdraw from Augsburg, where he had attended the legate, and to return to his own country. But before his departure, according to a form of which there had been some examples, he prepared a solemn appeal from the pope, ill-informed at that time concerning his cause, to the pope, when he should receive more full intimation with respect to it.—Cajetan, enraged at Luther's abrupt retreat, and at the publication of his appeal, wrote to the elector of Saxony, complaining of both; and requiring him, as he regarded the peace of the church, or the authority of its head, either to send that seditious monk a prisoner to Rome, or to banish him out of his territories. Frederic had hitherto, from political motives, protected Luther, as thinking he might be of use in checking the enormous power of the see of Rome; and though all Germany resounded with his fame, the elector had never yet admitted him into his presence. But upon this demand made by the cardinal, it became necessary to throw off somewhat of his former reserve. He had been at great expence and bestowed much attention on founding a new university, an object of considerable importance to every German prince; and foreseeing how fatal a blow the removal of Luther would be to its reputation, he not only declined complying with either of the pope's requests, but openly discovered great concern for Luther's safety.

The situation of our reformer, in the mean time, became daily more and more alarming. He knew very well what were the motives which induced the elector to afford him protection, and that he could by no means depend on a continuance of his friendship. If he should be obliged to quit Saxony, he had no other asylum, and must stand exposed to whatever punishment the rage or bigotry of his enemies could inflict; and so ready were his adversaries to condemn him, that he had been declared a heretic at Rome before the expiration of the 60 days allowed him in the citation for making his appearance. Notwithstanding all this, however, he discovered no symptoms of timidity or remissness; but continued to vindicate his own conduct and opinions, and to inveigh against those of his adversaries with more vehemence than ever. Being convinced, therefore, that the pope would soon proceed to the most violent measures against him, he appealed to a general council, which he affirmed to be the representative of the Catholic church, and superior in power to the pope, who being a fallible man, might err, as St Peter, the most perfect of his predecessors, had done.

The court of Rome were equally assiduous in the mean time to crush the author of these new doctrines which gave them so much uneasiness. A bull was issued by the pope, of a date prior to Luther's appeal, in which he magnified the virtues of indulgences, and subjected to the heaviest ecclesiastical censures all who presumed to teach a contrary doctrine. Such a clear decision of the sovereign pontiff against him might have been very fatal to Luther's cause, had not the death of the emperor Maximilian, which happened on January 17. 1519, contributed to give matters a different turn. Both the principles and interest of Maximilian had prompted him to support the authority of the see of Rome: but, in consequence of his death, the vicariate of that part of Germany which is governed by the Saxon laws devolved to the elector of Saxony; and, under the shelter of his friendly administration, Luther himself enjoyed tranquillity; and his opinions took such root in different places, that they could never afterwards be eradicated. At the same time, as the election of an emperor was a point more interesting to the pope (Leo X.) than a theological controversy which he did not understand, and of which he could not foresee the consequences, he was so extremely solicitous not to irritate a prince of such considerable influence in the electoral college as Frederick, that he discovered a great unwillingness to pronounce the sentence of excommunication against Luther, which his adversaries continually demanded with the most clamorous importunity.

From the reason just now given, and Leo's natural aversion to severe measures, a suspension of proceeding against Luther took place for 18 months, though perpetual negociations were carried on during this interval in order to bring the matter to an amicable issue. The manner in which these were conducted having given our reformer many opportunities of observing the corruption of the court of Rome, its obstinacy in adhering to established errors, and its indifference about truth, however clearly proposed or strongly proved, he began, in 1520, to utter some doubts with regard to the divine original of the papal authority, which he publicly disputed with Eccius, one of his most learned and formidable antagonists. The dispute was indecisive, both parties claiming the victory; but it must have been very mortifying to the partizans of the Romish church to hear such an essential point of their doctrine publicly attacked.

The papal authority being once suspected, Luther proceeded to push on his inquiries and attacks from one doctrine to another, till at last he began to shake the firmest foundations on which the wealth and power of the church were established. Leo then began to perceive that there were no hopes of reclaiming such an incorrigible heretic; and therefore prepared to denounce the sentence of excommunication against him. The college of cardinals was often assembled, in order to prepare the sentence with due deliberation; and the ablest canonists were consulted how it might be expressed with unexceptionable formality. At last it was issued on the 15th of June 1520. Forty-one propositions, extracted out of Luther's works, were therein condemned as heretical, scandalous, and offensive to pious ears; all persons were forbidden to read his writings, upon pain of excommunication: such as had any of them in their custody were commanded to commit them to the flames; he himself, if he did not, within 60 days, publicly recant his errors, and burn his books, was pronounced an obstinate heretic, excommunicated, and delivered to Satan for the destruction of the flesh: and all secular princes were required, under pain of incurring the same censure, to seize his person, that he might be punished as his crimes deserved.

Luther was not in the least disconcerted by this sentence, which he had for some time expected. He renewed his appeal to a general council; declared the pope to be that antichrist, or man of sin, whose appearance is foretold in the New Testament; declaimed against his tyranny with greater vehemence than ever; and at last, by way of retaliation, having assembled all the professors and students in the university of Wittemberg, with great pomp, and in the presence of a vast multitude of spectators, he cast the volumes of the canon law, together with the bull of excommunication, into the flames. The manner in which this action was justified gave still more offence than the action itself. Having collected from the canon law some of the most extravagant propositions with regard to the plenitude and omnipotence of the pope's power, as well as the subordination of all secular jurisdiction to his authority, he published these with a commentary, pointing out the impiety of such tenets, and their evident tendency to subvert all civil government.

On the accession of Charles V. to the empire, Luther found himself in a very dangerous situation. Charles, in order to secure the pope's friendship, had determined to treat him with great severity. His eagerness to gain this point, rendered him not averse to gratify the papal legates in Germany, who insisted, that without any delay or formal deliberation, the diet then sitting at Worms ought to condemn a man whom the pope had already excommunicated as an incorrigible heretic. Such an abrupt manner of proceeding, however, being deemed unprecedented and unjust by the members

Luther. members of the diet, they made a point of Luther's appearing in perſon, and declaring whether he adhered or not to thoſe opinions which had drawn upon him the cenſures of the church. Not only the emperor, but all the princes through whoſe territories he had to paſs, granted him a ſafe-conduct; and Charles wrote to him at the ſame time, requiring his immediate attendance on the diet, and renewing his promiſes of protection from any injury or violence. Luther did not heſitate one moment about yielding obedience; and ſet out for Worms, attended by the herald who had brought the emperor's letter and ſafe-conduct. While on his journey, many of his friends, whom the fate of Huſs, under ſimilar circumſtances, and notwithſtanding the ſame ſecurity of an imperial ſafe-conduct, filled with ſolicitude, adviſed and entreated him not to ruſh wantonly into the midſt of danger. But Luther, ſuperior to ſuch terrors, ſilenced them with this reply, "I am lawfully called (ſaid he) to appear in that city; and thither will I go in the name of the Lord, though as many devils as there are tiles on the houſes were there combined againſt me."

The reception which he met with at Worms, was ſuch as might have been reckoned a full reward of all his labours, if vanity and the love of applauſe had been the principles by which he was influenced. Greater crowds aſſembled to behold him than had appeared at the emperor's public entry; his apartments were daily filled with princes and perſonages of the higheſt rank; and he was treated with an homage more ſincere, as well as more flattering, than any which preeminence in birth or condition can command. At his appearance before the diet, he behaved with great decency, and with equal firmneſs. He readily acknowledged an exceſs of acrimony and vehemence in his controverſial writings; but refuſed to retract his opinions unleſs he were convinced of their falſehood, or to conſent to their being tried by any other rule than the word of God. When neither threats nor intreaties could prevail on him to depart from this reſolution, ſome of the eccleſiaſtics propoſed to imitate the example of the council of Conſtance, and, by puniſhing the author of this peſtilent hereſy, who was now in their power, to deliver the church at once from ſuch an evil. But the members of the diet refuſing to expoſe the German integrity to freſh reproach by a ſecond violation of public faith, and Charles being no leſs unwilling to bring a ſtain upon the beginning of his adminiſtration by ſuch an ignominious action, Luther was permitted to depart in ſafety. A few days after he left the city, a ſevere edict was publiſhed in the emperor's name, and by authority of the diet, depriving him, as an obſtinate and excommunicated criminal, of all the privileges which he enjoyed as a ſubject of the empire, forbidding any prince to harbour or protect him, and requiring all to ſeize his perſon as ſoon as the term ſpecified in his protection ſhould be expired.

But this rigorous decree had no conſiderable effect; the execution of it being prevented partly by the multiplicity of occupations which the commotions in Spain, together with the wars in Italy and the Low Countries, created to the emperor; and partly by a prudent precaution employed by the elector of Saxony, Luther's faithful patron. As Luther, on his return from Worms, was paſſing near Altenſtrain in Thuringia, a number of horſemen in maſks ruſhed ſuddenly out of a wood, where the elector had appointed them to lie in wait for him, and ſurrounding his company, carried him, after diſmiſſing all his attendants, to Wortburg, a ſtrong caſtle not far diſtant. There the elector ordered him to be ſupplied with every thing neceſſary or agreeable; but the place of his retreat was carefully concealed, until the fury of the preſent ſtorm againſt him began to abate, upon a change in the political ſyſtem of Europe. In this ſolitude, where he remained nine months, and which he frequently called his *Patmos*, after the name of that iſland to which the apoſtle John was baniſhed, he exerted his uſual vigour and induſtry in defence of his doctrines, or in confutation of his adverſaries, publiſhing ſeveral treatiſes, which revived the ſpirit of his followers, aſtoniſhed to a great degree and diſheartened at the ſudden diſappearance of their leader.

Luther, weary at length of his retirement, appeared publicly again at Wittemberg, upon the 6th of March 1522. He appeared indeed without the elector's leave; but immediately wrote him a letter to prevent his taking it ill. The edict of Charles V. as ſevere as it was, had given little or no check to Luther's doctrine; for the emperor was no ſooner gone to Flanders, than his edict was neglected and deſpiſed, and the doctrine ſeemed to ſpread even faſter than before. Caroloſtadius, in Luther's abſence, had puſhed things on faſter than his leader; and had attempted to aboliſh the uſe of maſs, to remove images out of the churches, to ſet aſide auricular confeſſion, invocation of ſaints, the abſtaining from meats; had allowed the monks to leave their monaſteries, to neglect their vows, and to marry; in ſhort, had quite changed the doctrine and diſcipline of the church at Wittemberg: all which, though not againſt Luther's ſentiments, was yet blamed by him, as being raſhly and unſeaſonably done. Lutheraniſm was ſtill confined to Germany: it was not got to France; and Henry VIII. of England made the moſt rigorous acts to hinder it from invading his realm. Nay, he did ſomething more: to ſhow his zeal for religion and the holy ſee, and perhaps his ſkill in theological learning, he wrote a treatiſe *Of the ſeven ſacraments*, againſt Luther's book *Of the captivity of Babylon*; which he preſented to Leo X. in October 1521. The pope received it very favourably; and was ſo well pleaſed with the king of England, that he complimented him with the title of *Defender of the Faith*. Luther, however, paid no regard to his kingſhip: but anſwered him with great ſharpneſs, treating both his perſon and performance in the moſt contemptuous manner. Henry complained of Luther's rude uſage of him to the princes of Saxony; and Fiſher, biſhop of Rocheſter, replied to his anſwer, in behalf of Henry's treatiſe; but neither the king's complaint, nor the biſhop's reply, was attended with any viſible effects.

Luther, though he had put a ſtop to the violent proceedings of Caroloſtadius, now made open war with the pope and biſhops; and, that he might make the people deſpiſe their authority as much as poſſible, he wrote one book againſt the pope's bull, and another againſt the order falſely called the *order of biſhops*. The ſame year, 1522, he wrote a letter, dated July the 29th to the aſſembly of the ſtates of Bohemia; in

Luther.

in which he assured them that he was labouring to establish their doctrine in Germany, and exhorted them not to return to the communion of the church of Rome; and he published also this year, a translation of the New Testament in the German tongue, which was afterwards corrected by himself and Melancthon. This translation having been printed several times, and being in every body's hands, Ferdinand archduke of Austria, the emperor's brother, made a very severe edict, to hinder the farther publication of it; and forbade all the subjects of his imperial majesty to have any copies of it, or of Luther's other books. Some other princes followed his example; and Luther was so angry at it, that he wrote a treatise, *Of the secular power*, in which he accuses them of tyranny and impiety. The diet of the empire was held at Nuremberg, at the end of the year; to which Hadrian VI. sent his brief, dated November the 25th: for Leo X. died upon the 2d of December 1521, and Hadrian had been elected pope upon the 9th of January following. In this brief, among other things, he observes to the diet, how he had heard with grief, that Martin Luther, after the sentence of Leo X. which was ordered to be executed by the edict of Worms, continued to teach the same errors, and daily to publish books full of heresies: that it appeared strange to him, that so large and so religious a nation could be seduced by a wretched apostate friar: that nothing, however, could be more pernicious to Christendom; and that therefore he exhorts them to use their utmost endeavours to make Luther, and the authors of these tumults, return to their duty: or, if they refuse and continue obstinate, to proceed against them according to the laws of the empire, and the severity of the last edict.

The resolution of this diet was published in the form of an edict, upon the 6th of March 1523; but it had no effect in checking the Lutherans, who still went on in the same triumphant manner. This year Luther wrote a great many pieces: among the rest, one upon the dignity and office of the supreme magistrate; which Frederic elector of Saxony is said to have been highly pleased with. He sent, about the same time a writing in the German language to the Waldenses, or Pickards, in Bohemia and Moravia, who had applied to him "about worshipping the body of Christ in the eucharist." He wrote also another book, which he dedicated to the senate and people of Prague, "about the institution of ministers of the church." He drew up a form of saying mass. He wrote a piece, entitled, *An example of popish doctrine and divinity;* which Dupin calls *a satire against nuns and those who profess a monastic life*. He wrote also against the vows of virginity, in his preface to his commentary on 1 Cor. viii. And his exhortations here were, it seems, followed with effects; for soon after, nine nuns, among whom was Catharine de Bore, eloped from the nunnery at Nimptschen, and were brought, by the assistance of Leonard Coppen, a burgess of Torgau, to Wittemberg. Whatever offence this proceeding might give to the Papists, it was highly extolled by Luther; who, in a book written in the German language, compares the deliverance of these nuns from the slavery of a monastic life to that of the souls which Jesus Christ has delivered by his death. This year Luther had occasion to canonize two of his followers, who, as Melchior Adam relates, were burnt at Brussels in the beginning of July, and were the first who suffered martyrdom for his doctrine. He wrote also a consolatory epistle to three noble ladies at Misnia, who were banished from the duke of Saxony's court at Friburg, for reading his books.

Luther.

In the beginning of the year 1524, Clement VII. sent a legate into Germany to the diet, which was to be held at Nuremburg. Hadrian VI. died in October 1523, and was succeeded by Clement upon the 19th of November. A little before his death he canonized Benno, who was bishop of Meissen in the time of Gregory VII. and one of the most zealous defenders of the holy see. Luther, imagining that this was done directly to oppose him, drew up a piece with this title, *Against the New Idol and Old Devil set up at Meissen;* in which he treats the memory of Gregory with great freedom, and does not spare even Hadrian. Clement VII.'s legate represented to the diet of Nuremburg the necessity of enforcing the execution of the edict of Worms, which had been strangely neglected by the princes of the empire; but, notwithstanding the legate's solicitations, which were very pressing, the decrees of that diet were thought so ineffectual, that they were condemned at Rome, and rejected by the emperor. It was in this year that the dispute between Luther and Erasmus, about free-will, began. Erasmus had been much courted by the Papists to write against Luther; but he was all along of opinion, that writing would not be found an effectual way to end the differences and establish the peace of the church. However, tired out at length with the importunities of the pope and the catholic princes, and desirous at the same time to clear himself from the suspicion of favouring a cause which he would not seem to favour, he resolved to write against Luther, though, as he tells Melancthon, it was with some reluctance, and chose free-will for the subject. His book was intitled, *A Diatriba, or Conference about Free-will;* and was written with much moderation, and without personal reflections. He tells Luther in the preface, "That he ought not to take his dissenting from him in opinion ill, because he had allowed himself the liberty of differing from the judgement of popes, councils, universities, and doctors of the church." Luther was some time before he answered Erasmus's book; but at last published a treatise *De Servo Arbitrio*, or *Of the Servitude of Man's Will;* and though Melancthon had promised Erasmus, that Luther should answer him with civility and moderation, yet Luther had so little regard to Melancthon's promise, that he never wrote any thing sharper. He accused Erasmus of being careless about religion, and little solicitous what became of it, provided the world continued in peace; and that his notions were rather philosophical than Christian. Erasmus immediately replied to Luther, in a piece called *Hyperaspistes;* in the first part of which he answers his arguments, and in the second his personal reflections.

In October 1524, Luther threw off the monastic habit; which, though not premeditated and designed, was yet a very proper preparative to a step he took the year after; we mean, his marriage with Catharine de Bore. Catharine de Bore was a gentleman's daughter, who had been a nun, and was taken, as we have observed, out of the nunnery of Nimptschen, in the year

Luther. year 1525. Luther had a defign, as Melchior Adam related, to marry her to Glacius, a minifter of Ortamunden; but fhe did not like Glacius; and fo Luther married her himfelf upon the 13th of June 1525. This conduct of his was blamed not only by the Catholics, but, as Melancthon fays, by thofe of his own party. He was even for fome time afhamed of it himfelf; and owns, that his marriage had made him fo defpicable, that he hoped his humiliation would rejoice the angels, and vex the devils. Melancthon found him fo afflicted with what he had done, that he wrote fome letters of confolation to him. It was not fo much the marriage, as the circumftances of the time, and the precipitation with which it was done, that occafioned the cenfures paffed upon Luther. He married all of a fudden, and at a time when Germany was groaning under the miferies of a war which was faid at leaft to be owing to Lutheranifm. Then, again, it was thought an indecent thing in a man of 42 years of age, who was then, as he pretended, reftoring the Gofpel, and reforming mankind, to involve himfelf in marriage with a woman of 26, either through incontinence, or any account whatever. But Luther, as foon as he had recovered himfelf a little from this abafhment, affumed his former air of intrepidity, and boldly fupported what he had done with reafons. "I took a wife (fays he), in obedience to my father's commands; and haftened the confummation, in order to prevent impediments, and ftop the tongues of flanderers." It appears from his own confeffion, that this reformer was very fond of Mrs de Bore, and ufed to call her *his Catharine*, which made profane people think and fay wicked things of him: "And therefore (fays he) I married of a fudden, not only that I might not be obliged to hear the clamours which I knew would be raifed againft me, but to ftop the mouths of thofe who reproached me with Catharine de Bore." Luther alfo gives us to underftand, that he did it partly as concurring with his grand fcheme of oppofing the Catholics.

Luther, notwithftanding, was not himfelf altogether fatisfied with thefe reafons. He did not think the ftep he had taken could be fufficiently juftified upon the principles of human prudence; and therefore we find him, in other places, endeavouring to account for it from a fupernatural impulfe. But whether there was any thing divine in it or not, Luther found himfelf extremely happy in his new ftate, and efpecially after his wife had brought him a fon. "My rib Kate (fays he in the joy of his heart) defires her compliments to you, and thanks you for the favour of your kind letter. She is very well, through God's mercy. She is obedient and complying with me in all things; and more agreeable, I thank God, than I could have expected; fo that I would not change my poverty for the wealth of Crœfus." He was heard to fay (Seckendorf tells us,) that he would not exchange his wife for the kingdom of France, nor for the riches of the Venetians; and that for three reafons: Becaufe fhe had been given him by God, at the time when he implored the affiftance of the Holy Ghoft in finding a good wife; fecondly, Becaufe, though fhe was not without faults, yet fhe had fewer than other women; and, thirdly, Becaufe fhe religioufly obferved the conjugal fidelity fhe owed him. There went at firft a report, that Catharine de Bore was brought to bed foon after her marriage with Luther; but Erafmus, who had wrote that news to his friends, acknowledged the falfity of it a little after. Luther.

His marriage, however, did not retard his activity and diligence in the work of reformation. He revifed the Augfburg confeffion of faith, and apology for the Proteftants, when the Proteftant religion was firft eftablifhed on a firm bafis. See PROTESTANTS and REFORMATION.

After this, Luther had little elfe to do than to fit down and contemplate the mighty work he had finifhed: for that a fingle monk fhould be able to give the church fo rude a fhock, that there needed but fuch another entirely to overthrow it, may very well feem a mighty work. He did indeed little elfe: for the remainder of his life was fpent in exhorting princes, ftates, and univerfities, to confirm the reformation which had been brought about through him; and publifhing from time to time fuch writings as might encourage, direct, and aid, them in doing it. The emperor threatened temporal punifhment with armies, and the pope eternal with bulls and anathemas; but Luther cared for none of their threats. His friend and coadjutor Melancthon was not fo indifferent; for Melancthon had a great deal of softnefs, moderation, and diffidence in his make, which made him very uneafy, and even forrowful, in the prefent diforders. Hence we find many of Luther's letters written on purpofe to fupport and comfort him under thefe feveral diftreffes and anxieties.

In the year 1533, Luther wrote a confolatory epiftle to the citizens of Ofchatz, who had fuffered fome hardfhips for adhering to the Augfburg confeffion of faith; in which, among other things, he fays; "The devil is the hoft, and the world is his inn; fo that wherever you come, you fhall be fure to find this ugly hoft." He had alfo about this time a terrible controverfy with George duke of Saxony, who had fuch an averfion to Luther's doctrine, that he obliged his fubjects to take an oath that they would never embrace it. However, 60 or 70 citizens of Leipfic were found to have deviated a little from the Catholic way in fome point or other, and they were known previoufly to have confulted Luther about it; upon which George complained to the elector John, that Luther had not only abufed his perfon, but alfo preached up rebellion among his fubjects. The elector ordered Luther to be acquainted with this; and to be told at the fame time, that if he did not clear himfelf of the charge, he could not poffibly efcape punifhment. But Luther eafily refuted the accufation, by proving, that he had been fo far from ftirring up his fubjects againft him, on the fcore of religion, that on the contrary, he had exhorted them rather to undergo the greateft hardfhips, and even fuffer themfelves to be banifhed.

In the year 1534, the Bible tranflated by him into German was firft printed, as the old privilege, dated at Bibliopolis, under the elector's hand, fhows: and it was publifhed the year after. He alfo publifhed this year a book againft maffes and the confecration of priefts, in which he relates a conference he had with the devil upon thofe points; for it is remarkable in Luther's whole hiftory, that he never had any conflicts of any kind within, but the devil was always his antagonift.

Luther.

gonift. In February 1537, an affembly was held at Smalkald about matters of religion, to which Luther and Melancthon were called. At this meeting Luther was feized with fo grievous an illnefs, that there were no hopes of his recovery. He was afflicted with the ftone, and had a ftoppage of urine for 11 days. In this terrible condition he would needs undertake to travel, notwithftanding all that his friends could fay or do to prevent him: his refolution, however, was attended with a good effect; for the night after his departure he began to be better. As he was carried along, he made his will, in which he bequeathed his deteftation of Popery to his friends and brethren; agreeably to what he often ufed to fay: *Peftis eram vivus, moriens ero mors tua, papa;* that is, "I was the plague of Popery in my life, and fhall continue to be fo in my death."

This year the pope and the court of Rome, finding it impoffible to deal with the Proteftants by force, began to have recourfe to ftratagem. They affected therefore to think, that though Luther had indeed carried things on with a high hand and to a violent extreme, yet what he had pleaded in defence of thefe meafures was not entirely without foundation. They talked with a feeming fhow of moderation: and Pius III. who fucceeded Clement VII. propofed a reformation firft among themfelves, and even went fo far as to fix a place for a council to meet at for that purpofe. But Luther treated this farce as it deferved to be treated; unmafked and detected it immediately; and, to ridicule it the more ftrongly, caufed a picture to be drawn, in which was reprefented the pope feated on high upon a throne, fome cardinals about him with foxes tails on, and feeming to evacuate upwards and downwards (*furfum deorfum repurgare*, as Melchior Adam expreffes it). This was fixed over againft the title-page, to let the readers fee at once the fcope and defign of the book; which was, to expofe that cunning and artifice with which thofe fubtle politicians affected to cleanfe and purify themfelves from their errors and fuperftitions. Luther publifhed about the fame time A Confutation of the pretended Grant of Conftantine to Sylvefter Bifhop of Rome; and alfo fome letters of John Hufs, written from his prifon at Conftance to the Bohemians.

In this manner was Luther employed till his death, which happened in the year 1546. That year, accompanied by Melancthon, he paid a vifit to his own country, which he had not feen for many years, and returned again in fafety. But foon after he was called thither again by the earls of Mansfeldt, to compofe fome differences which had arifen about their boundaries. Luther had not been ufed to fuch matters; but becaufe he was born at Eifleben, a town in the territory of Mansfeldt, he was willing to do his country what fervice he could, even in this way. Preaching his laft fermon therefore at Wittemberg, upon the 17th of January, he fet off on the 23d; and at Hall in Saxony lodged with Juftus Jonas, with whom he ftaid three days, becaufe the waters were out. Upon the 28th, he paffed over the river with his three fons and Dr Jonas; and being in fome danger, he faid to the Doctor, "Do not you think it would rejoice the devil exceedingly, if I and you, and my three fons, fhould be drowned?" When he entered the territories of the earls of Mansfeldt, he was received by 100 horfemen or more, and conducted in a very honourable manner; but was at the fame time fo very ill, that it was feared he would die. He faid, that thefe fits of ficknefs often came upon him when he had any great bufinefs to undertake: of this, however, he did not recover; but died upon the 18th of February, in the 63d year of his age. A little before he expired, he admonifhed thofe that were about him to pray to God for the propagation of the Gofpel: "becaufe (faid he) the council of Trent, which had fat once or twice, and the pope, would devife ftrange things againft it." Soon after, his body was put into a leaden coffin, and carried with funereal pomp to the church at Eifleben, when Dr Jonas preached a fermon upon the occafion. The earls of Mansfeldt defired that his body fhould be interred in their territories; but the elector of Saxony infifted upon his being brought back to Wittemberg; which was accordingly done: and there he was buried with the greateft pomp that perhaps ever happened to any private man. Princes, earls, nobles, and ftudents without number, attended the proceffion; and Melancthon made his funeral oration.

A thoufand lies were invented by the Papifts about Luther's death. Some faid that he died fuddenly; others, that he killed himfelf; others, that the devil ftrangled him; others, that his corpfe ftunk fo abominably, that they were forced to leave it in the way, as it was carried to be interred. Nay, lies were invented about his death, even while he was yet alive. Luther, however, to give the moft effectual refutation of this account of his death, put forth an advertifement of his being alive; and, to be even with the Papifts for the malice they had fhown in this lie, wrote a book at the fame time to prove, that "the papacy was founded by the devil."

Luther's works were collected after his death, and printed at Wittemberg in 7 vols folio. Catharine de Bore furvived her hufband a few years; and continued the firft year of her widowhood at Wittemberg, though Luther had advifed her to feek another place of refidence. She went from thence in the year 1547, when the town was furrendered to the emperor Charles V. Before her departure, fhe had received a prefent of 50 crowns from Chriftian III. king of Denmark; and the elector of Saxony, and the counts of Mansfeldt, gave her good tokens of their liberality. With thefe additions to what Luther had left her, fhe had wherewithal to maintain herfelf and her family handfomely. She returned to Wittemberg, when the town was reftored to the elector; where fhe lived in a very devout and pious manner, till the plague obliged her to leave it again in the year 1552. She fold what fhe had at Wittemberg: and retired to Torgau, with a refolution to end her life there. An unfortunate mifchance befel her in her journey thither, which proved fatal to her. The horfes growing unruly, and attempting to run away, fhe leaped out of the vehicle fhe was conveyed in; and, by leaping, got a fall, of which fhe died about a quarter of a year after, at Torgau, upon the 20th of December 1552. She was buried there in the great church, where her tomb and epitaph are ftill to be feen; and the univerfity of Wittemberg, which was then at Torgau becaufe the plague raged at Wittemberg,

berg, made a public programma concerning the funeral pomp.

LUTHERANISM, the ſentiments of Martin Luther with regard to religion. See LUTHER.

Lutheraniſm has undergone ſome alterations ſince the time of its founder.—Luther rejected the epiſtle of St James as inconſiſtent with the doctrine of St Paul, in relation to juſtification; he alſo ſet aſide the Apocalypſe: both which are now received as canonical in the Lutheran church.

Luther reduced the number of ſacraments to two, viz. baptiſm, and the euchariſt: but he believed the impanation, or conſubſtantiation, that is, that the matter of the bread and wine remain with the body and blood of Chriſt; and it is in this article that the main difference between the Lutherans and Engliſh churches conſiſts.

Luther maintained the maſs to be no ſacrifice; exploded the adoration of the hoſt, auricular confeſſion, meritorious works, indulgences, purgatory, the worſhip of images, &c. which had been introduced in the corrupt times of the Romiſh church. He alſo oppoſed the doctrine of free will, maintained predeſtination, and aſſerted our juſtification to be ſolely by the imputation of the merits and ſatisfaction of Chriſt. He alſo oppoſed the faſtings in the Roman church, monaſtical vows, the celibate of the clergy, &c.

LUTHERANS, the Chriſtians who follow the opinions of Martin Luther, one of the principal reformers of the church in the 16th century. See LUTHER.

The Lutherans, of all Proteſtants, are thoſe who differ leaſt from the Romiſh church; as they affirm, that the body and blood of Chriſt are materially preſent in the ſacrament of the Lord's ſupper, though in an incomprehenſible manner; and likewiſe repreſent ſome religious rites and inſtitutions, as the uſe of images in churches, the diſtinguiſhing veſtments of the clergy, the private confeſſion of ſins, the uſe of wafers in the adminiſtration of the Lord's ſupper, the form of exorciſm in the celebration of baptiſm, and other ceremonies of the like nature, as tolerable, and ſome of them as uſeful. The Lutherans maintain, with regard to the divine decrees, that they reſpect the ſalvation or miſery of men, in conſequence of a previous knowledge of their ſentiments and characters, and not as free and unconditional, and as founded on the mere will of God. Towards the cloſe of the laſt century, the Lutherans began to entertain a greater liberality of ſentiment than they had before adopted; though in many places they perſevered longer in ſevere and deſpotic principles than other Proteſtant churches. Their public teachers now enjoy an unbounded liberty of diſſenting from the deciſions of thoſe ſymbols or creeds which were once deemed almoſt infallible rules of faith and practice, and of declaring their diſſent in the manner they judge the moſt expedient. Moſheim attributes this change in their ſentiments to the maxim which they generally adopted, that Chriſtians were accountable to God alone for their religious opinions; and that no individual could be juſtly puniſhed by the magiſtrate for his erroneous opinions, while he conducted himſelf like a virtuous and obedient ſubject, and made no attempts to diſturb the peace and order of civil ſociety.

LUTHERN, in *Architecture*, a kind of window over the cornice, in the roof of a building; ſtanding perpendicularly over the naked of a wall, and ſerving to illuminate the upper ſtory.

Lutherns are of various forms; as ſquare, ſemicircular, round, called *bull's eyes*, *flat arches*, &c.

LUTRA, in *Zoology*. See MUSTELA, MAMMALIA *Index*.

LUTTI, BENEDITTO, an eminent painter, born at Florence in 1666. He was the diſciple of Antonio Dominico Gabiani, and his merit was judged equal to that of his maſter: he painted few beſide caſel pieces; and his works were much valued and ſought for in England, France, and Germany. The emperor knighted him; and the elector of Mentz, together with his patent of knighthood, ſent him a croſs ſet with diamonds. Lutti was never ſatisfied in finiſhing his pictures; yet though he often retouched them, they never appeared laboured. He died in 1724.

LUTZEN, a town of Upper Saxony in Germany; famous for a battle fought here in 1632, when Guſtavus Adolphus king of Sweden was killed. It is ſituated on the river Elſter, in E. Long. 12. 37. N. Lat. 51. 20.

LUXATION, is when any bone is moved out of its place of articulation, ſo as to impede or deſtroy its proper office or motion. See SURGERY.

LUXEMBURG, a city of the Auſtrian Netherlands, and capital of a duchy of the ſame name. It is ſeated partly on a hill, and partly on a plain; it is very ſtrong both by art and nature. It is but indifferently built, though there are ſome good ſtone houſes in it. There is nothing very remarkable among the ſtructures but the Jeſuits church; which is a handſome edifice, after the modern taſte. It was taken by Louis XIV. in 1684; who ſo augmented the fortifications, that it is now one of the ſtrongeſt towns in Europe. It was ceded to Spain by the treaty of Ryſwick; but the French took it again in 1701, and gave it up to the houſe of Auſtria by the treaty of Utrecht. It is 25 miles ſouth-weſt of Treves, and 100 weſt of Mentz. E. Long. 6. 10. N. Lat. 49. 52.

LUXEMBURG, the duchy of, is one of the 17 provinces of the Netherlands. It is bounded on the eaſt by the archbiſhopric of Treves; on the ſouth by Lorrain; on the weſt, partly by Champagne, and partly by the biſhopric of Liege, which likewiſe, with part of Limburg, bound it on the north. It lies in the foreſt of Ardenne, which is one of the moſt famous in Europe. In ſome places it is covered with mountains and woods, and in general it is fertile in corn and wine; and here are a great number of iron mines. The principal rivers are the Moſelle, the Sour, the Ourte, and the Semoy. It belongs partly to the houſe of Auſtria, and partly to the French; and Thionville is the capital of the French part.

LUXEMBURG, *François Henry de Montmorenci*, duke of, and marſhal of France, a renowned general in the ſervice of Louis XIV. was born in 1628. He was with the prince of Condé at the battle of Rocroy, in 1643; and in 1668 diſtinguiſhed himſelf at the conqueſt of Franche Compté. In 1672, he commanded in chief the French army in Holland; when he defeated the enemy near Woerden and Bodegrave, and was univerſally admired for the fine retreat he made in 1673. He became marſhal of France in 1675; gained the battle of Fleurs in 1690, that of Steenkirk in in 1692, and that of Nerwind in 1693. He died in Verſailles in 1695.

LUXURIANS FLOS, "a luxuriant or double flower;" a flower, ſome of whoſe parts are increaſed in number, to the diminution or entire excluſion of others.

The parts that are augmented or multiplied in luxuriant flowers, are the flower-cup and petals, which Linnæus conſiders as the teguments or covers of the flower; the parts that are diminiſhed, or entirely excluded, are the ſtamina or chives, which the ſame author denominates the male organs of generation.

Luxuriance in flowers is capable of the three following varieties.

1. A flower is ſaid to be MULTIPLIED (*flos multiplicatus*), when the increaſe of the petals is not ſuch as to exclude all the ſtamina: in this ſenſe, flowers are properly ſaid to be double, triple, or quadruple, according to the number of multiplications of the petals.

2. A flower is ſaid to be FULL (*flos plenus*), when, by the multiplication of the petals, all the ſtamina are excluded. Such are moſt of the double flowers that engage the attention of floriſts.

3. A flower is ſaid to be PROLIFIC (*flos prolifer*), which produces flowers, and ſometimes leaves, from its centre.

For a particular deſcription of each of theſe kinds of luxuriance in flowers, ſee the articles *Multiplicatus Flos*, *Plenus Flos*, and *Prolifer Flos*.

Many natural orders of plants do not in any circumſtances produce luxuriant flowers. Of this kind are the maſqued flowers of Tournefort, excepting calve's-ſnout; the rough-leaved, umbelliferous, ſtarry plants, and ſuch as flower at the joints, of Ray: ſome umbelliferous flowers, however, are *prolific*.

The pea-bloom, or butterfly-ſhaped flowers, are rarely rendered double; ſome inſtances, however, of luxuriance, are obſerved in a ſpecies of lady's finger, coronilla, and broom.

All luxuriant flowers are vegetable monſters. Such as are perfectly full, by which we mean the greateſt degree of luxuriance, cannot be propagated by ſeeds; becauſe theſe, for want of impregnation, can never ripen. Full flowers therefore are very properly denominated by Linnæus *eunuchs*. This higheſt degree of luxuriance is very common in carnation, lychnis, anemone, ſtock, Indian creſs, roſe, marſh marigold, ranunculus, violet, peony, and narciſſus.

Flowers which do not exclude all the ſtamina, perfect their ſeeds. Of this kind are poppy, fennel-flower, campanula, and ſome others.

Some flowers, as thoſe of the water-lily, fig-marigold, and cactus, have many rows or ſeries of petals, without the number of ſtamina being in the leaſt diminiſhed. Such flowers are by no means to be reckoned luxuriant, in the flighteſt degree.

Luxuriance in flowers is generally owing to exceſs of nouriſhment.

LUXURY; voluptuouſneſs, or an extravagant indulgence in diet, dreſs, and equipage.

Luxury, among the Romans, prevailed to ſuch a degree, that ſeveral laws were made to ſuppreſs, or at leaſt limit it. The extravagance of the table began about the time of the battle of Actium, and continued in great exceſs till the reign of Galba. Peacocks, cranes of Malta, nightingales, veniſon, wild and tame fowl, were conſidered as delicacies. A profuſion of proviſions was the reigning taſte. Whole wild boars were often ſerved up, and ſometimes they were filled with various ſmall animals, and birds of different kinds: this diſh they called the *Trojan horſe*, in alluſion to the wooden horſe filled with ſoldiers. Fowls and game of all ſorts were ſerved up in whole pyramids, piled up in diſhes as broad as moderate tables. Lucullus had a particular name for each apartment; and in whatever room he ordered his ſervants to prepare the entertainment, they knew by the direction the expence to which they were to go. When he ſupped in the Apollo, the expence was fixed at 50,000 *drachmæ*, that is 1250l. M. Antony provided eight boars for 12 gueſts. Vitellius had a large ſilver platter, ſaid to have coſt a million of *ſeſterces*, called *Minerva's buckler*. In this he blended together the livers of gilt-heads, the brains of pheaſants and peacocks, the tongues of phenicopters, and the milts of lampreys. Caligula ſerved up to his gueſts pearls of great value diſſolved in vinegar; the ſame was done alſo by Clodius the ſon of Æſop the tragedian. Apicius laid aſide 90,000,000 of *ſeſterces*, beſides a mighty revenue, for no other purpoſe but to be ſacrificed to luxury; finding himſelf involved in debt, he looked over his accounts, and though he had the ſum of 10,000,000 of *ſeſterces* ſtill left, he poiſoned himſelf for fear of being ſtarved to death.

The Roman laws to reſtrain luxury were *Lex Orchia*, *Fannia*, *Didia*, *Licinia*, *Cornelia*, and many others: But all theſe were too little; for as riches increaſed amongſt them, ſo did ſenſuality.

What were the ideas of luxury entertained in England about two centuries ago, may be gathered from the following paſſage of Holinſhed; who, in a diſcourſe prefixed to his Hiſtory, ſpeaking of the increaſe of luxury, ſays, "Neither do I ſpeak this in reproach of any man, God is my judge; but to ſhow, that I do rejoice rather to ſee how God has bleſſed us with his good gifts, and to behold how that in a time wherein all things are grown to the moſt exceſſive prices, we yet do find means to obtain and atchieve ſuch furniture as heretofore was impoſſible. There are old men yet dwelling in the village where I remain, which have noted three things to be marvelouſly altered in England within their ſound remembrance. One is the multitude of chimneys lately erected; whereas in their young days there were not above two or three, if ſo many, in moſt uplandiſh towns of the realm (the religious houſes, and manor places of their lords, always excepted, and peradventure ſome great perſonages), but each made his fire againſt a reredoſs [ſkreen] in the hall where he dreſſed his meat and dined.—The ſecond is the great amendment of lodging; for, ſaid they, our fathers and we ourſelves have lain full oft upon ſtraw pallets covered only with a ſheet, under coverlits made of a dogſwaine or horharriots (to uſe their own terms), and a good log under their head inſtead of a bolſter.—If it were ſo that the father or goodman of the houſe had a mattraſs, or flock bed and ſheets, a ſack of chaff to reſt his head upon, he thought himſelf to be as well lodged as the lord of the town. So well were they contented, that pillows (ſaid they) were thought meet

Luxury. only for women in childbed; as for ſervants, if they had any ſheet above them, it was well; for ſeldom had they any under their bodies to keep them from pricking ſtraws, that ran oft through the canvas and their hardened hides.—The third thing they tell of, is the exchange of treene [wooden] platters into pewter, and wooden ſpoons into ſilver or tin; for ſo common were all ſorts of treene veſſels in old times, that a man ſhould hardly find four pieces pewter (of which one was peradventure a ſalt) in a good farmer's houſe. Again, In times paſt, men were contented to dwell in houſes builded of ſallow, willow, &c. ſo that the uſe of oak was in a manner dedicated wholly unto churches, religious houſes, princes palaces, navigation, &c. But now willow, &c. are rejected, and nothing but oak anywhere regarded; and yet ſee the change, for when our houſes were builded of willow, then had we oaken men; but now that our houſes are come to be made of oak, our men are not only become willow, but a great many altogether of ſtraw, which is a ſore alteration. In theſe the courage of the owner was a ſufficient defence to keep the houſe in ſafety; but now the aſſurance of the timber muſt defend the men from robbing. Now have we many chimneys, and yet our tenderlins complain of rheums, catarrhs, and poſes; then had we none but reredoſes, and our heads did never ach. For as the ſmoke in thoſe days were ſuppoſed to be a ſufficient hardening for the timber of the houſe; ſo it was reputed a far better medicine to keep the goodman and his family from the quacks or poſe; wherewith, as then, very few were acquainted. Again, Our pewterers in time paſt employed the uſe of pewter only upon diſhes and pots, and a few other trifles for ſervice; whereas now they are grown into ſuch exquiſite cunning, that they can in a manner imitate by infuſion any form or faſhion, of cup, diſh, ſalt, bowl, or goblet, which is made by the goldſmith's craft, though they be ever ſo curious and very artificially forged. In ſome places beyond the ſea, a garniſh of good flat Engliſh pewter (I ſay flat, becauſe diſhes and platters in my time began to be made deep, and like baſons, and are indeed more convenient both for ſauce and keeping the meat warm) is eſteemed ſo precious as the like number of veſſels that are made of fine ſilver."

Particular inſtances of luxury, in *eating*, however, might be adduced from an earlier period, ſurpaſſing even the extravagance of the Romans. Thus, in the 10th year of the reign of Edward IV. (1470), George Nevill, brother to the earl of Warwick, at his inſtalment into the archiepiſcopal ſee of York, entertained moſt of the nobility and principal clergy, when his bill of fare was 300 quarters of wheat, 350 tuns of ale, 104 tuns of wine, a pipe of ſpiced wine, 80 fat oxen, ſix wild bulls, 1004 weathers, 300 hogs, 300 calves, 3000 geeſe, 3000 capons, 300 pigs, 100 peacocks, 200 cranes, 200 kids, 2000 chickens, 4000 pigeons, 4000 rabbits, 204 bitterns, 4000 ducks, 200 pheaſants, 500 partridges, 200 woodcocks, 400 plovers, 100 curlews, 100 quails, 1000 egrets, 200 rees, 400 bucks, does, and roebucks, 1506 hot veniſon paſties, 4000 cold ditto, 1000 diſhes of jelly parted, 4000 diſhes of jelly plain, 4000 cold cuſtards, 2000 hot cuſtards, 300 pikes, 300 breams, eight ſeals, four porpuſſes, 400 tarts. At this feaſt the earl of Warwick was ſteward, the earl of Bedford treaſurer, and Lord Haſtings comptroller, with many more noble officers; Luxury. 1000 ſervitors, 62 cooks, 515 menial apparitors in the kitchen.—But ſuch was the fortune of the man, that after his extreme prodigality he died in the moſt abject but unpitied poverty, *vinctus jacuit in ſumma inopia*.

And as to *dreſs*, luxury in that article ſeems to have attained a great height long before Holinſhed's time: For in the reign of Edward III. we find no fewer than ſeven ſumptuary laws paſſed in one ſeſſion of parliament to reſtrain it. It was enacted, that men ſervants of lords, as alſo of tradeſmen and artiſans, ſhall be content with one meal of fiſh or fleſh every day; and the other meals, daily, ſhall be of milk, cheeſe, butter and the like. Neither ſhall they uſe any ornaments of gold, ſilk, or embroidery; nor their wives and daughters any veils above the price of twelvepence. Artiſans and yeomen ſhall not wear cloth above 40s. the whole piece (the fineſt then being about 6l. per piece), nor the ornaments before named. Nor the women any veils of ſilk, but only thoſe of thread made in England. Gentlemen under the degree of knights, not having 100l. yearly in land, ſhall not wear any cloth above $4\frac{1}{2}$ marks the whole piece. Neither ſhall they or their females uſe cloth of gold, ſilver, or embroidery, &c. But eſquires having 200l. per annum or upwards of rent, may wear cloths of five marks the whole piece of cloth; and they and their females may alſo wear ſtuff of ſilk, ſilver, ribbons, girdles, or furs. Merchants, citizens, burghers, and artificers or tradeſmen, as well of London as elſewhere, who have goods and chattels of the clear value of 500l. and their females, may wear as is allowed to gentlemen and eſquires of 100l. per annum. And merchants, citizens, and burgeſſes, worth above 1000l. in goods and chattels, may (and their females) wear the ſame as gentlemen of 200l. per annum. Knights of 200 marks yearly may wear cloth of ſix marks the cloth, but no higher; but no cloth of gold, nor furred with ermine: but all knights and ladies having above 400 marks yearly, up to 1000l. per annum, may wear as they pleaſe, ermine excepted; and they may wear ornaments of pearl and precious ſtones for their heads only. Clerks having degrees in cathedrals, colleges, &c. may wear as knights and eſquires of the ſame income. Plowmen, carters, ſhepherds, and ſuch like, not having 40s. value in goods or chattels, ſhall wear no ſort of cloth but blanket and ruſſet lawn of 12d. and ſhall wear girdles and belts; and they ſhall only eat and drink ſuitable to their ſtations. And whoſoever uſes other apparel than is preſcribed by the above laws ſhall forfeit the ſame.

Concerning the general utility of luxury to a ſtate, there is much controverſy among the political writers. Baron Monteſquieu lays it down, that luxury is neceſſary in monarchies, as in France; but ruinous to democracies, as in Holland. With regard therefore to Britain, whoſe government is compounded of both ſpecies, it is held to be a dubious queſtion, how far private luxury is a public evil; and, as ſuch, cognizable by public laws. And indeed our legiſlators have ſeveral times changed their ſentiments as to this point; for formerly there were a number of penal laws exiſting to reſtrain exceſs in apparel, chiefly made in the reigns of Edward III. IV. and Henry VIII. a ſpecimen of which we have inſerted above. But all of them it appeared expedient to repeal at an after period. In fact, although luxury will of neceſſity increaſe according to the influx of wealth, it may not be for the general benefit of commerce to impoſe, as in the above cited laws, an abſolute prohibition of every degree of it: yet, for the good of the public, it may be neceſſary that ſuch as go beyond proper bounds in eating, drinking, and wearing, what by no means is ſuitable to their ſtation, ſhould be taxed accordingly, could it be done without including thoſe who have a better title to ſuch indulgence. This is certainly, however, a point which ſhould be maturely weighed before executed; and, in mercantile countries at leaſt, ſuch reſtraints may be found prejudicial, moſt likely impracticable, eſpecially where true liberty is eſtabliſhed. Sir William Temple obſerves, ſpeaking of the trade and riches, and at the ſame time of the *frugality* of the Hollanders, "That ſome of our maxims are not ſo *certain* as *current* in politics: as that encouragement of exceſs and luxury if employed in the conſumption of *native* commodities, is of advantage to trade. It may be ſo to that which impoveriſhes, but not to that which enriches a country. It is indeed leſs prejudicial, if it lies in *native* than in *foreign* wares: but the humour of *luxury* and expence cannot ſtop at certain bounds; what begins in *native* will proceed to *foreign* commodities; and though the example ariſe among idle perſons, yet the imitation will run into all degrees, even of thoſe men by whoſe induſtry the nation ſubſiſts. And beſides, the more of *our own* we ſpend, the leſs ſhall we have to ſend abroad; and ſo it will come to paſs, that while we drive a vaſt trade, yet, by buying much more than we *ſell*, we ſhall come to be poor at laſt."

LYBIA, or Libya, a name anciently given to all that part of Africa lying between the border of Egypt and the river Triton; and comprehending *Cyrenaica*, *Marmarica*, and the Regio *Syrtica*. See theſe articles.

LYCÆUM, Λυκειον, in antiquity, the name of a celebrated ſchool or academy at Athens, where Ariſtotle explained his philoſophy. The place was compoſed of porticoes and trees planted in the quincunx form, where the philoſophers diſputed walking. Hence *philoſophy of the Lycæum* is uſed to ſignify the philoſophy of Ariſtotle, or the Peripatetic philoſophy. Suidas obſerves, that the Lycæum took its name from its having been originally a temple of Apollo Lycæus; or rather a portico or gallery built by Lycæus ſon of Apollo; but others mention it to have been built by Piſiſtratus or Pericles.

LYCÆUS, in *Ancient Geography*, a mountain of Arcadia, ſacred to Jupiter; whence *Jupiter Lycæus* (Pliny). Sacred alſo to Pan (Virgil); and hence *Lycæa*, the rites performed to Pan on this mountain; which Evander carrying with him to Latium, were called *Lupercalia* (Virgil).

LYCAON, in fabulous hiſtory, the firſt king of Arcadia, ſon of Pelaſgus and Melibœa. He built a town called Lycoſura, on the top of Mount Lycæus, in honour of Jupiter. He had many wives, by whom he had a daughter called Calliſto, and 50 ſons. He was ſucceeded on the throne by Nyctimus, the eldeſt of his ſons. He lived about 1820 years before the Chriſtian era.—Another king of Arcadia, celebrated for his cruelties. He was changed into a wolf by Jupiter, becauſe he offered human victims on the altar of the god Pan. Some attribute this metamorphoſis to another cauſe. The ſins of mankind, as they relate, were become ſo enormous, that Jupiter viſited the earth to puniſh wickedneſs and impiety. He came to Arcadia, where he was announced as a god, and the people began to pay proper adoration to his divinity. Lycaon, however, who uſed to ſacrifice all ſtrangers to his wanton cruelty, laughed at the pious prayers of his ſubjects; and to try the divinity of the god, he ſerved up human fleſh on his table. This impiety ſo irritated Jupiter, that he immediately deſtroyed the houſe of Lycaon, and changed him into a wolf.

LYCAONIA, in *Ancient Geography*, a ſmall country of the Hither Aſia, contained between Pamphylia to the ſouth, Cappadocia to the north, Piſidia and Phrygia to the weſt, and Armenia Minor to the eaſt. *Lycaones*, the people. This country, though ſituated very near Mount Taurus, and part of it on it, yet the Romans reckoned it in Aſia intra Taurum. *Arcadia*, anciently called *Lycaonia* (Stephanus.)—Alſo an iſland in the Tiber, joined to Rome by a bridge, and to the land by another, namely, the Ceſtius and Fabricius.

LYCHNIS, campion, including alſo the *Bachelor's-button*, *Catch-fly*, &c.; a genus of plants belonging to the pentandria claſs; and in the natural method ranking under the 22d order, *Caryophyllæ*. See Botany *Index*.

LYCIA, a country of Aſia Minor, bounded by the Mediterranean on the ſouth, Caria on the weſt, Pamphylia on the eaſt, and Phrygia on the north. It was anciently called *Milyas* and *Tremile*, from the Milyæ, or Solymi, a people of Crete, who came to ſettle there. The country received the name of *Lycia* from Lycus the ſon of Pandion, who eſtabliſhed himſelf there. The inhabitants have been greatly commended by all the ancients for their ſobriety and juſtice. They were conquered by Crœſus king of Lydia, and afterwards by Cyrus. Though they were ſubject to the power of Perſia, yet they were governed by their own kings, and only paid a yearly tribute to the Perſian monarch. They became part of the Macedonian empire when Alexander came into the eaſt, and afterwards were ceded to the houſe of the Seleucidæ. The country was reduced into a Roman province by the emperor Claudius.

LYCIUM, a genus of plants belonging to the pentandria claſs; and in the natural method ranking under the 28th order, *Luridæ*. See Botany *Index*.

LYCODONTES, the petrified teeth of the lupuspiſcis, or wolf-fiſh, frequently found foſſile. They are of different ſhapes; but the moſt common kind riſe into a ſemiorbicular form, and are hollow within, ſomewhat reſembling an acorn-cup; this hollow is found ſometimes empty, and ſometimes filled with the ſtratum in which it is immerſed. Many of them have an outer circle, of a different colour from the reſt.

LYCOMEDES, in fabulous hiſtory, a king of Scyros, an iſland in the Ægean ſea. He was ſon of Apollo and Parthenope. He was ſecretly intruſted with the care of young Achilles, whom his mother Thetis had diſguiſed in woman's clothes, to remove him from the Trojan war, where ſhe knew he muſt unavoidably periſh. Lycomedes has rendered himſelf famous for his treachery to Theſeus, who had implored his protection when

when driven from his throne of Athens by the ufurper Mneftheus. Lycomedes, as it is reported, either envious of the fame of his illuftrious gueft, or bribed by the emiffaries of Mneftheus, led Thefeus to an elevated place, on pretence to fhow him the extent of his dominions, and perfidioufly threw him down a precipice, where he was killed.

LYCOPERDON, a genus of plants belonging to the cryptogamia clafs. See BOTANY *Index*.

LYCOPERSICON. See SOLANUM, BOTANY *Index*.

LYCOPHRON, a famous Greek poet and grammarian, born at Colchis in Eubœa, flourifhed about 304 B. C. and, according to Ovid, was killed by an arrow. He wrote 20 tragedies; but all his works are loft, except a poem entitled *Caffandra*, which contains a long train of predictions, which he fuppofes to have been made by Caffandra, Priam's daughter. This poem is extremely obfcure. The beft edition of it is that of Dr Potter, printed at Oxford in 1697, folio.

LYCOPODIUM, or CLUB-MOSS; a genus of plants belonging to the cryptogamia clafs. See BOTANY *Index*.

LYCOPOLIS, or LYCON, in *Ancient Geography*, fo called from the worfhip of wolves. *Lycopolitæ*, the people; *Lycopolites*, the diftrict. There were two towns of this name, one in the Delta, or Lower Egypt, near the Mediterranean; the other in the Thebais, or Higher Egypt, in the northern part, to the weft of the Nile.

LYCOPSIS, a genus of plants belonging to the pentandria clafs; and in the natural method ranking under the 41ft order, *Afperifoliæ*. See BOTANY *Index*.

LYCOPUS, a genus of plants belonging to the diandria clafs; and in the natural method ranking under the 42d order, *Verticillatæ*. See BOTANY *Index*.

LYCURGIA, a feftival obferved by the Spartans, in memory of their lawgiver Lycurgus, whom they honoured with a temple and anniverfary facrifice.

LYCURGUS, the celebrated legiflator of the Spartans, was the fon of Eunomes king of Sparta.——He travelled to Greece, to the ifle of Crete, to Egypt, and even to the Indies, to converfe with the fages and learned men of thofe countries, and to learn their manners, their cuftoms, and their laws. After the death of his brother Polydectes, who was king of Sparta, his widow offered the crown to Lycurgus, promifing that fhe would make herfelf mifcarry of the child of which fhe was pregnant, provided he would marry her; but Lycurgus nobly refufed thefe advantageous offers, and afterwards contented himfelf with being tutor to his nephew Charillus, and reftored to him the government when he came of age; but notwithftanding this regular and generous conduct, he was accufed of a defign to ufurp the crown. This calumny obliged him to retire to the ifland of Crete, where he applied himfelf to the ftudy of the laws and cuftoms of nations. At his return to Lacedemon, he reformed the government: and, to prevent the diforders occafioned by luxury and the love of riches, he prohibited the ufe of gold and filver; placed all the citizens in a ftate of equality; and introduced the ftricteft temperance, the moft exact difcipline, and thofe admirable laws which (a few excepted) have been celebrated by all hiftorians. It is faid, that, to engage the Lacedemonians to obferve them inviolably, he made them promife with an oath not to change any part of them till his return; and that he afterwards went to the ifland of Crete, where he killed himfelf, after having ordered that his afhes fhould be thrown into the fea, for fear leaft if his body fhould be carried to Sparta the Lacedemonians would think themfelves abfolved from their oath. He flourifhed about 870 B. C.

LYDD, a town of England, in Kent, two miles and a half fouth-weft of Romney, of which town and port it is a member, and 71 miles from London. It is a populous town, and is incorporated by the name of a bailiff, jurats, and commonalty. In the beach near Stone-end, is a heap of ftones, fancied to be the tomb of Crifpin and Crifpianus; and near the fea is a place called *Holmftone*, confifting of beach and pebble-ftones, which abounds with holm trees.

LYDGATE, JOHN, called the *Monk of Bury;* not, as Cibber conjectures, becaufe he was a native of that place, for he was born about the year 1380, in the village of Lydgate: but becaufe he was a monk of the Benedictine convent at St Edmund's-Bury. After ftudying fome time in our Englifh univerfities, he travelled to France and Italy: and, having acquired a competent knowledge of the languages of thofe countries, he returned to London, where he opened a fchool, in which he inftructed the fons of the nobility in polite literature. At what time he retired to the convent of St Edmund's-Bury, does not appear; but he was certainly there in 1415. He was living in 1446, aged about 66; but in what year he died is not known. Lydgate, according to Pits, was an elegant poet, a perfuafive rhetorician, an expert mathematician, an acute philofopher, and a tolerable divine. He was a voluminous writer; and, confidering the age in which he lived, an excellent poet. His language is lefs obfolete, and his verfification much more harmonious, than the language and verfification of Chaucer, who wrote about half a century before him. He wrote, 1. Hiftory of the Theban war, printed at the end of Chaucer's works, 1561, 1602, 1687. 2. Poemation of good counfel; at the end of Chaucer's works. 3. The life of Hector; London 1594, folio, printed by Grofs, dedicated to Henry V. 4. Life of the Bleffed Virgin; printed by Caxton. 5. The proverbs of Lydgate upon the fall of princes; printed by Wink. Word. London, 4to. 6. Difpute of the horfe, the fheep, and the goofe; printed in Caxton's Collect. 4to. 7. The temple of brafs; among the works of Chaucer. 8. London lickpenny; vide Stow's hiftory, &c. &c. Befides an incredible number of other poems and tranflations preferved in various libraries, and of which the reader will find a catalogue in Bifhop Tanner.

LYDIA, in *Ancient Geography*, a celebrated kingdom of Afia Minor.—All the ancient writers tell us, that Lydia was firft called *Mæonia* or *Meonia*, from Meon king of Phrygia and Lydia; and that it was known under no other denomination till the reign of Atys, when it began to be called *Lydia* from his fon Lydus. Bochart finding in his learned collection of Phœnician words the verb *luz*, fignifying "to wind," and obferving that the country we are fpeaking of is watered by the Mæander fo famous for its windings, concludes that it was thence named *Lydia*, or *Ludia*.

As

Lydia.

As to the ancient name of Mæonia, he takes it to be a Greek tranflation of the Phœnician word *lud;* wherein he agrees in fome meafure with Stephanus, who derives the name of Mæonia from Mæon the ancient name of the Mæander. Some take the word *mæonia* to be a tranflation of a Hebrew word fignifying "metal," becaufe that country, fay they, was in former times enriched above any other with mines. Though Lydia and Mæonia are by moft authors indifferently ufed for one and the fame country, yet they are fometimes diftinguifhed; that part where Mount Tmolus ftood, watered by the Pactolus, being properly called *Mæonia;* and the other, lying on the coaft, *Lydia.* This diftinction is ufed by Homer, Callimachus, Dionyfius, and other ancient writers. In after ages, when the Ionians, who had planted a colony on the coaft of the Egean fea, began to make fome figure, that part was called *Ionia*, and the name of *Lydia* given to the ancient Mæonia.—Lydia, according to Pliny, Ptolemy, and other ancient geographers, was bounded by Myfia Major on the north, by Caria on the fouth, by Phrygia Major on the eaft, and Ionia on the weft, lying between the 37th and 39th degrees of north latitude. What the ancients ftyle the kingdom of *Lydia* was not confined within thefe narrow boundaries, but extended from Halys to the Egean fea. Pliny's defcription includes Æolia, lying between the Hermus and the Caïcus.

As to the origin of the Lydians, Jofephus, and after him all the ecclefiaftical writers, derive them from Lud, Shem's fourth fon; but this opinion has no other foundation than the fimilitude of names. Some of the ancients will have the Lydians to be a mixed colony of Phrygians, Myfians, and Carians. Others finding fome conformity in religion and religious ceremonies between the Egyptians and Tufcans who were a Lydian colony, conclude them, without any farther evidence, to be originally Egyptians. All we know for certain is, that the Lydians were a very ancient nation, as is manifeft from their very fables; for Atys, Tantalus, Pelops, Niobe, and Arachne, are all faid to have been the children of Lydus. And Zanthus in his *Lydiaca*, quoted by Stephanus, informs us, that the ancient city of Afcalon, one of the five fatrapies of the Philiftines, mentioned in the books of Jofhua and the Judges, was built by one Afcalus a Lydian, whom Achiamus king of Lydia had appointed to command a body of troops which he fent, we know not on what occafion, into Syria. The Heraclidæ, or kings of Lydia defcended from Hercules, began to reign before the Trojan war; and had been preceded by a long feries of fovereigns fprung from Atys, and hence ftyled *Atyadæ;* a ftrong proof of the antiquity of that kingdom.

The Lydians began very early to be ruled by kings, whofe government feems to have been truly defpotic, and the crown hereditary. We read of three diftinct races of kings reigning over Lydia, viz. the Atyadæ, the Heraclidæ, and the Mermnadæ.

The *Atyadæ* were fo called from Atys the fon of Cotys, and grandfon of Manes the firft Lydian king. But the hiftory of this family is obfcure and fabulous.

The Atyadæ were fucceeded by the *Heraclidæ*, or the defcendants of Hercules. For Hercules being, by the direction of the oracle, fold as a flave to Omphale a queen of Lydia, to expiate the murder of Iphitus, had, during his captivity, by one of her flaves, a fon named *Cleolaus*, whofe grandfon Argon was the firft of the Heraclidæ that afcended the throne of Lydia. This race is faid to have reigned 505 years, the fon fucceeding the father for 22 generations. They began to reign about the time of the Trojan war. The laft of the family was the unhappy Candaules, who loft both his life and kingdom by his imprudence: An event of which we have the following account by Herodotus. Candaules had a wife whom he paffionately loved, and believed the moft beautiful of her fex. He extolled her charms to Gyges his favourite, whom he ufed to intruft with his moft important affairs; and the more to convince him of her beauty, refolved to fhow her to him quite naked: he accordingly placed him in the porch of her chamber where the queen ufed to undrefs when fhe went to bed, ordering him to retire after he fhould have feen her, and take all poffible care not to be obferved. But notwithftanding all the caution he could ufe, fhe plainly difcovered him going out; and though fhe did not doubt but it was her hufband's contrivance, yet fhe paffed that night in a feeming tranquillity, fuppreffing her refentment till next morning, when fhe fent for Gyges, and refolutely told him that he muft either by his death atone for the criminal action he had been guilty of, or put to death Candaules the contriver of it, and receive both her and the kingdom of Lydia for his reward. Gyges at firft earneftly begged of her that fhe would not drive him to the neceffity of fuch a choice. But finding that he could not prevail with her, and that he muft either kill his mafter or die himfelf, he chofe the former part of the alternative. Being led by the queen to the fame place where her hufband had pofted him the night before, he ftabbed the king while he was afleep, married the queen, and took poffeffion of the kingdom, in which he was confirmed by the anfwer of the Delphic oracle. The Lydians having taken up arms to revenge the death of their prince, an agreement was made between them and the followers of Gyges, that if the oracle fhould declare him to be lawful king of Lydia, he fhould be permitted to reign; if not, he fhould refign the crown to the Heraclidæ. The anfwer of the oracle proving favourable to Gyges, he was univerfally acknowledged for lawful king of Lydia. Candaules is faid to have purchafed a picture painted by Bularchas, reprefenting a battle of the Magnetes, for its weight in gold; a circumftance which fhows how early the art of painting began to be in requeft, for Candaules was cotemporary with Romulus.

Gyges having thus poffeffed himfelf of the kingdom of Lydia, fent many rich and valuable prefents to the oracle of Delphos, among others, fix cups of gold weighing 30 talents, and greatly efteemed for the workmanfhip. He made war on Miletus and Smyrna, took the city of Colophon, and fubdued the whole country of Troas. In his reign, and by his permiffion, the city of Abydus was built by the Milefians. Plutarch and other writers relate his acceffion to the crown of Lydia in a quite different manner, and tells us, without making any mention of the queen, that Gyges rebelled againft Candaules and flew him in an engagement. In Gyges began the third

Lydia.

race called *Mermnadæ;* who were alfo, properly fpeaking, Heraclidæ, being defcended from a fon of Hercules by Omphale. Gyges reigned 38 years, and was fucceeded by his fon Ardyes.

This prince carried on the war againft the Milefians which his father had begun, and poffeffed himfelf of Priene, in thofe days a ftrong city. In his reign the Cimmerians invaded and overran all Afia Minor; but what battles were fought between the Lydians and thefe invaders, and with what fuccefs, we find no where mentioned. Herodotus only informs us, that in the time of Ardyes they poffeffed themfelves of Sardis, the metropolis of Lydia, but could never reduce the caftle. Ardyes reigned 49 years, and was fucceeded by his fon Sadyattes, who reigned 12 years, and warred moft part of his reign with the Milefians.

After him came his fon Alyattes, who for the fpace of five years continued the war which his father had begun againft the Milefians, ravaging their country, and about harveft time carrying away all their corn yearly, in order to oblige them, for want of provifions, to furrender their city, which he knew he could not reduce any other way, the Milefians being at that time mafters of the fea. In the 12th year of this war the Lydians having fet fire to the corn in the fields, the flames were carried by a violent wind, which happened to blow at that time, to the temple of Minerva at Affefus, and burnt it down to the ground. Not long after, Alyattes falling fick, fent to confult the oracle at Delphos; which refufed to return any anfwer till fuch time as the king fhould rebuild the temple of Minerva at Affefus. Alyattes, thus warned, difpatched ambaffadors to Miletus, enjoining them to conclude a truce with the Milefians till the temple fhould be rebuilt. On the arrival of the ambaffadors, Thrafybulus, then king of Miletus, commanded all the corn that was at that time in the city to be brought into the market-place, ordering the citizens to banquet in public, and revel as if the city were plentifully ftored with all manner of provifions. This ftratagem Thrafybulus practifed, to the end that the ambaffadors feeing fuch quantities of corn, and the people everywhere diverting themfelves, might acquaint their mafter with their affluence, and divert him from purfuing the war. As Thrafybulus had defigned, fo it happened; for Alyattes, who believed the Milefians greatly diftreffed for provifions, receiving a different account from his ambaffadors, changed the truce into a lafting peace, and ever afterwards lived in amity and friendfhip with Thrafybulus and the Milefians. He was fucceeded, after a reign of 57 years, by his fon Crœfus, whofe uninterrupted profperity, in the firft years of his reign, far eclipfed the glory of all his predeceffors. He was the firft that made war on the Ephefians, whofe city he befieged and took notwithftanding their confecrating it to Diana, and faftening the walls by a rope to her temple, which was feven ftadia diftant from the city. After the reduction of Ephefus he attacked, under various pretences, the Ionians and Æolians, obliging them, and all the other Greek ftates of Afia, to pay him a yearly tribute. Having met with fuch extraordinary fuccefs by land, the Lydian prince determined to render his power equally confpicuous by fea. For this purpofe he thought ferioufly of equipping a fleet; with which he purpofed to invade and conquer the Grecian iflands directly fronting his dominions. But this defign, which, confidering the flow progrefs in maritime power among the nations moft diligent to attain it, would probably have failed of fuccefs, was prevented by the advice of a philofophical traveller conveyed in fuch a lively turn of wit, as eafily changed the refolution of the king. Bias of Priene in Ionia, fome fay Pittacus of Mitylene in the ifle of Lefbos, while he travelled after the Grecian cuftom, from curiofity and a love of knowledge, was prefented to Crœfus at the Lydian court; and being afked by that prince what news from Greece; he anfwered with a republican freedom, that the iflanders had collected powerful fquadrons of cavalry with an intention of invading Lydia. "May the gods grant (faid Crœfus), that the Greeks, who are unacquainted with horfemanfhip, fhould attack the difciplined valour of the Lydian cavalry; there would foon be an end to the conteft." "In the fame manner (replied Bias), as if the Lydians, who are totally unexperienced in naval affairs, fhould invade the Grecians by fea." Struck by the acutenefs of this unexpected obfervation, Crœfus defifted from his intended expedition againft the iflands, and inftead of employing new means for extending his conquefts, determined peaceably to enjoy the laurels which he had won, and to difplay the grandeur which he had attained. But his happinefs was foon after allayed by the death of his favourite fon Atys, who was unfortunately killed at the chafe of a wild boar. For this lofs he continued difconfolate for two years and in a ftate of inaction, till the conquefts of Cyrus, and growing power of the Perfians, roufed up his martial fpirit, and diverted his mind to other thoughts. He apprehended that the fuccefs which attended Cyrus in all his undertakings, might at laft prove dangerous to himfelf, and therefore refolved to put a ftop, if poffible, to his progrefs. In taking this refolution, which might probably be attended with the moft important confequences, he was defirous to learn the will of heaven concerning the iffue of the war. The principal oracles which he confulted were thofe of Branchis in Ionia, of Hammon in Libya, and of Delphi in Greece. Among thefe refpected fhrines, the oracle of Delphi maintained its afcendant, as the moft faithful interpreter of fate. Crœfus was fully perfuaded of its veracity; and defirous generoufly to compenfate for the trouble which he had already given, and ftill meant to give, the priefts of Apollo, he facrificed 3000 oxen to the god, and adorned his fhrine with dedications equally valuable for the workmanfhip and for the materials; precious veffels of filver, ewers of iron beautifully inlaid and enamelled; various ornaments of pure gold, particularly a golden lion weighing ten talents, and a female figure three cubits or near five feet high. In return for thefe magnificent prefents, the oracle, in ambiguous language, flattered Crœfus with obtaining an eafy victory over his enemies, and with enjoying a long life and a profperous reign. The god at the fame time enjoined him to contract an alliance with the moft powerful of the Grecian ftates.

Elevated with thefe favourable predictions of Apollo, Crœfus prepared to yield a ready obedience to the only condition required on his part for the accomplifhment of his afpiring purpofe. Not deeming himfelf fufficiently acquainted with the affairs of Greece, to

Lydia.

to know what particular republic was meant by the oracle, he made particular inquiry of thofe beft informed concerning the ftate of Europe; and difcovered, that among all the members of the Grecian confederacy, the Athenians and Lacedemonians were juftly entitled to the pre-eminence. In order to learn which of thefe communities deferved the epithet of *moft powerful*, it was neceffary to fend ambaffadors into Greece. The Lydians defpatched with this important commiffion, foon difcovered that the Athenians after having been long haraffed by internal diffenfions, were actually governed by the tyrant Pififtratus. The Spartans, on the other hand, though anciently the worft regulated of all the Grecian communities, had enjoyed domeftic peace and foreign profperity ever fince they had adopted the wife inftitutions of Lycurgus. After that memorable period, they had repeatedly conquered the warlike Argives, triumphed over the hardy Arcadians; and notwithftanding the heroic exploits of Ariftomenes, fubdued and enflaved their unfortunate rivals of Meffene. To the Lydian ambaffadors therefore, the Spartan republic appeared to be pointed out by the oracle as the community whofe alliance they were enjoined to folicit. Having repaired accordingly to Sparta, they were introduced not only to the kings and fenate, but, as the importance of the negociation required, to the general affembly of the Lacedemonians, to whom they, in few words, declared the object of their commiffion; "We are fent, O Lacedemonians! by Crœfus, king of the Lydians and of many other nations, who being commanded by the oracle of Apollò to feek the friendfhip of the moft powerful people of Greece, now fummons you, who juftly merit that epithet, to become his faithful allies, in obedience to the will of the god whofe authority you acknowledge." The Lacedemonians, pleafed with the alliance of a warlike king, and ftill more with the fame of their valour, readily accepted the propofal. To the ftrict connexion of an offenfive and defenfive league, they joined the more refpected ties of facred hofpitality. A few years before this tranfaction, they had fent to purchafe gold at Sardis for making a ftatue of Apollo. Crœfus had on that occafion gratuitoufly fupplied their want. Remembering this generofity, they gave the Lydian ambaffadors at their departure, as a prefent for their mafter, a veffel of brafs containing 300 amphoras (above 12 hogfheads), and beautifully carved on the outfide with various forms of animals.

Crœfus, having thus happily accomplifhed the defign recommended by the oracle, was eager to fet out upon his intended expedition. He had formerly entered into alliance with Amafis king of Egypt, and Labynetus king of Babylon. He had now obtained the friendfhip of the moft warlike nation of Europe. The newly raifed power of Cyrus and the Perfians feemed incapable of refifting fuch a formidable confederacy.

Elevated with thefe flattering ideas of his own invincible greatnefs, Crœfus waited not to attack the Perfian dominions until he had collected the ftrength of his allies. The fanguine impetuofity of his temper, unexperienced in adverfity, unfortunately precipitated him into meafures no lefs ruinous than daring. Attended only by the arms of Lydia, and a numerous band of mercenaries, whom his immenfe wealth enabled him at any time to call into his fervice, he marched towards the river Halys; and having croffed with much difficulty that deep and broad ftream, entered the province of Cappadocia, which formed the weftern frontier of the Median dominions. That unfortunate country foon experienced all the calamities of invafion. The Pterian plain, the moft beautiful and the moft fertile diftrict of Cappadocia, was laid wafte; the ports of the Euxine, as well as feveral inland cities, were plundered; and the inoffenfive inhabitants were either put to the fword or dragged into captivity. Encouraged by the unrefifting foftnefs of the natives of thofe parts, Crœfus was eager to pufh forwards; and if Cyrus did not previoufly meet him in the field, he had determined to proceed in triumph to the mountains of Perfia. Againft this dangerous refolution he was in vain exhorted by a Lydian named Sandanis; who, when afked his opinion of the war, declared it with that freedom which the princes of the eaft have in every age permitted, amidft all the pride and caprices of defpotic power, to men diftinguifhed by the gifts of nature or education. "You are preparing, O king, to march againft a people who lead a laborious and a miferable life; whofe daily fubfiftence is often denied them, and is always fcanty and precarious; who drink only water, and who are clothed with the fkins of wild beafts. What can the Lydians gain by the conqueft of Perfia; they who enjoy all the advantages of which the Perfians are deftitute? For my part, I deem it a bleffing of the gods, that they have not excited the warlike poverty of thefe miferable barbarians to invade and plunder the luxurious wealth of Lydia." The moderation of this advice was rejected by the fatal prefumption of Crœfus; who confounding the dictates of experienced wifdom with the mean fuggeftions of pufillanimity, difmiffed the counfellor with contempt.

Meanwhile, the approach of Cyrus, who was not of a temper to permit his dominions to be ravaged with impunity, afforded the Lydian king an opportunity of bringing the war to a more fpeedy iffue than by his intended expedition into Perfia. The army of Cyrus gradually augmented on his march: the tributary princes cheerfully contributing with their united ftrength towards the affiftance of a mafter whofe valour and generofity they admired, and who now took arms to protect the fafety of his fubjects, as well as to fupport the grandeur of his throne. Such was the rapidity of his movement, efpecially after being informed of the deftructive ravages of the enemy in Cappadocia, that he arrived from the fhores of the Cafpian to thofe of the Euxine fea before the army of Crœfus had provided the neceffaries for their journey. That prince, when apprifed of the neighbourhood of the Perfians, encamped on the Pterian plain; Cyrus likewife encamped at no great diftance; frequent fkirmifhes happened between the light troops; and at length a general engagement was fought with equal fury and perfeverance, and only terminated by the darknefs of night. The lofs on both fides hindered a renewal of the battle. The numbers, as well as the courage of the Perfians, much exceeded the expectation of Crœfus. As they difcovered not any intention to harafs his retreat, he determined to move back towards Sardis, to fpend the winter in the amufements of his palace;

lace; and after ſummoning his numerous allies to his ſtandard, to take the field early in the ſpring with ſuch increaſe of force as ſeemed ſufficient to overpower the Perſians.

But this deſign was defeated by the careful vigilance of Cyrus. That experienced leader allowed the enemy to retire without moleſtation; carefully informing himſelf of every ſtep which they took, and of every meaſure which they ſeemed determined to purſue. Patiently watching the opportunity of a juſt revenge, he waited until Crœſus had re-entered his capital, and had diſbanded the foreign mercenaries, who compoſed the moſt numerous diviſion of his army. It then ſeemed the proper time for Cyrus to put his Perſians in motion; and ſuch was his celerity, that he brought the firſt news of his own arrival in the plain of Sardis. Crœſus, whoſe firmneſs might well have been ſhaken by the imminence of this unforeſeen danger, was not wanting on the preſent occaſion to the duties which he owed to his fame and the luſtre of the Lydian throne. Though his mercenaries were diſbanded, his own ſubjects, who ſerved him from attachment, who had been long accuſtomed to victory, and who were animated with a high ſenſe of national honour, burned with a deſire of enjoying an opportunity to check the daring inſolence of the invaders. Crœſus indulged and encouraged this generous ardour. The Lydians in that age fought on horſeback, armed with long ſpears; the ſtrength of the Perſians conſiſted in infantry. They were ſo little accuſtomed to the uſe of horſes, that camels were almoſt the only animals which they employed as beaſts of burden. This circumſtance ſuggeſted to a Mede, by name Harpagus, a ſtratagem, which being communicated to Cyrus, was immediately adopted with approbation by that prince. Harpagus, having obſerved that horſes had a ſtrong averſion to the ſhape and ſmell of camels, adviſed the Perſian army to be drawn up in the following order: All the camels which had been employed to carry baggage and proviſions were collected into one body, arranged in a long line fronting the Lydian cavalry. The foot ſoldiers of the Perſians were poſted immediately behind the line, and placed at a due diſtance. The Median horſe (for a few ſquadrons of theſe followed the ſtandard of Cyrus) formed the rear of the army. As the troops on both ſides approached to join battle, the Lydian cavalry, terrified at the unuſual appearance of the camels, mounted with men in arms, were thrown into diſorder, and turning their heads, endeavoured to eſcape from the field. Crœſus, who perceived the confuſion, was ready to deſpair of his fortune; but the Lydians, abandoning their horſes, prepared with uncommon bravery to attack the enemy on foot. Their courage deſerved a better fate; but unaccuſtomed as they were to this mode of fighting, they were received and repelled by the experienced valour of the Perſian infantry, and obliged to take refuge within the fortified ſtrength of Sardis, where they imagined themſelves ſecure. The walls of that city bid defiance to the rude art of attack, as then practiſed by the moſt warlike nations. If the Perſian army ſhould inveſt it, the Lydians were provided with proviſions for ſeveral years; and there was reaſon to expect, that in a few months, and even weeks, they would receive ſuch aſſiſtance from Egypt, Babylonia, and Greece (to which countries they had already ſent ambaſſadors), as would oblige the Perſians to raiſe the ſiege.

The Lydian miniſters deſpatched into Greece met with great ſympathy from the Spartans. That people were particularly obſervant of the faith of treaties; and while they puniſhed their enemies with unexampled ſeverity, they behaved with generous compaſſion towards thoſe whom they had once accepted for allies. They immediately reſolved therefore to ſend him a ſpeedy and effectual relief; and for this purpoſe aſſembled their troops, made ready their veſſels, and prepared every thing neceſſary for the expedition.

The valour of the Spartans might perhaps have upheld the ſinking empire of Lydia; but before their armament could ſet ſail, Crœſus was no longer a ſovereign. Notwithſtanding the ſtrength of Sardis, that city had been taken by ſtorm on the 20th day of the ſiege; the walls having been ſcaled in a quarter, which, appearing altogether inacceſſible, was too careleſsly guarded. This was effected by the enterpriſe of Hyreades a Mede, who accidentally obſerved a centinel deſcend part of the rock in order to recover his helmet. Hyreades was a native of the mountainous province of Mardia, and being accuſtomed to clamber over the dangerous precipices of his native country, reſolved to try his activity in paſſing the rock upon which he had diſcovered the Lydian. The deſign was more eaſily accompliſhed than he had reaſon to expect: emulation and ſucceſs encouraged the braveſt of the Perſians to follow his example; theſe were ſupported by greater numbers of their countrymen; the garriſon of Sardis was ſurpriſed; the citadel ſtormed; the rich capital of Lower Aſia ſubjected to the vengeful rapacity of an indignant victor. Thus ended the ancient kingdom of Lydia, which continued ſubject to the Perſians till they alſo were conquered by the Macedonians. For the fate of the Lydian monarch, ſee the article Croesus.

LYDIAT, Thomas, a learned Engliſh divine, born in 1572, and educated at Oxford. About the year 1609, he became acquainted with Dr James Uſher, afterwards archbiſhop of Armagh, who carried him to Ireland. He was at Dublin college for about two years, after which he returned to England; and the rectory of Alkrington becoming vacant, he was preſented to it: but at length, being engaged for the debts of a near relation, which for the preſent he was unable to pay, having before ſpent his patrimony in printing ſeveral books, he was ſent to priſon; and was confined at Oxford, in the King's Bench, and elſewhere, till Sir William Boſwell, a generous patron of learned men, Dr Robert Pink, warden of New college, Biſhop Uſher, and Dr Laud diſcharged the debt. In the civil wars, he ſuffered much in his rectory of Alkrington from the parliament party; was four times pillaged to the value of at leaſt 70l.; and was forced for a quarter of a year together to borrow a ſhirt to ſhift himſelf. He died in 1646. He wrote ſome pieces in Engliſh, and many works in Latin, on chronology and natural hiſtory.

LYDIUS lapis, in the natural hiſtory of the ancients; the name of the ſtone uſed by way of touchſtone for the trial of gold and ſilver, and called by ſome *Heraclius lapis;* both of which names were alſo applied by the ancients to the loadſtone; and hence has ariſen no ſmall miſunderſtanding of their works. Pliny has obſerved, that both the loadſtone and touchſtone were at times called *Lydius* and *Heraclius lapis.*

The true *lapis Lydius*, or the touchſtone, was anciently found only in the river Tmolus; but was afterwards found in many other places, and is now very common in many of the German rivers. The ancients give us very remarkable and circumſtantial accounts of the uſes they made of it; and it is plain they were able to diſcern the alloys of gold by means of it with very great exactneſs. We at preſent uſe ſeveral different ſtones under this name, and for the ſame purpoſe. In Italy, a green marble called *verdello*, is moſt frequently uſed; and with us, very frequently ſmall pieces of *baſalt.*

LYGEUM, a genus of plants belonging to the triandria claſs; and in the natural method ranking under the fourth order, *Gramina*. See BOTANY *Index*.

LYGII, LIGII, *Lugii*, or *Logiones*, in *Ancient Geography*, a people of Germany, to the weſt of the Viſtula, where it forms a bend like a creſcent; *Ligii*, (Dio); *Lugii*, (Strabo); *Logiones*, (Zoſimus). Their name *Lugii* is conjectured to be derived from their mutually cloſe confederacy or league. The Viſtula was their boundary to the north, eaſt, and ſouth, with Mount Aſciburgius to the weſt. Now the whole of that country lies in Poland, on this ſide the Viſtula.

LYING-IN WOMEN. See MIDWIFERY.

LYING-to, or *Lying-by*, the ſituation of a ſhip, when ſhe is retarded in her courſe, by arranging the ſails in ſuch a manner as to counteract each other with nearly an equal effort, and render the ſhip almoſt immoveable, with reſpect to her progreſſive motion, or headway. A ſhip is uſually brought-to by the main and fore top ſails, one of which is laid aback, whilſt the other is full; ſo that the latter puſhes the ſhip forward, whilſt the former reſiſts this impulſe, by forcing her aſtern. This is particularly practiſed in a general engagement, when hoſtile fleets are drawn up in two lines of battle oppoſite each other. It is alſo uſed to wait for ſome other ſhip, either approaching or expected; or to avoid purſuing a dangerous courſe, eſpecially in dark or foggy weather.

LYME-REGIS, a ſea port town of Dorſetſhire in England, 148 miles from London. It lies near the ſea, on the very borders of Devonſhire, in a cavity between two rocky hills, which makes it difficult of acceſs. It is about five furlongs long, and contains about 200 houſes. As it lies on the declivity of a hill, the houſes make a good ſhow, one above another; and ſome of them are built of freeſtone, and covered with blue ſlate. The corporation conſiſts of a mayor (who is juſtice of peace during his mayoralty and the year after, and in the third year both juſtice and coroner), a recorder, 15 capital burgeſſes, and a town clerk. This place had formerly a very flouriſhing trade to France, Spain, the Straits, Newfoundland, and the Weſt Indies; during which, the cuſtoms amounted ſome years to 16,000l. But it ſtands on ſuch a high ſteep rock, that the merchants are obliged to load and unload their goods at a place a quarter of a mile off, called the *Cobb*, originally built in the reign of Edward III. which coſts a great ſum to maintain, but forms ſuch a harbour as perhaps is not to be equalled in the world, the ſhips being ſheltered by a high thick ſtone wall, raiſed in the main ſea a good way from the ſhore, broad enough for carriages and warehouſes, and the cuſtomhouſe officers have one upon it. The cellars of the low part of the town, near the ſea, are however often overflowed by the ſpring tides 10 or 12 feet. There are guns planted for defence both of the Cobb and the town, the ſhore here being very proper for batteries. The cuſtomhouſe ſtands on pillars, with the corn market under it. There is an alms-houſe in Church ſtreet, alſo Preſbyterian and Anabaptiſt meeting-houſes. The town hall is near Broad-ſtreet. The church ſtands at the eaſt end of the town on a riſing ground. The market here is Friday, and there are two fairs in the year. We read, that in 774, the Saxon king Kinwulf gave land hereabouts to the church of Sherborn, for the boiling of ſalt there to ſupply its neceſſities. At this place the duke of Monmouth landed in 1685. A few years ago above 2000l. worth of gold and ſilver coin of Char. I. and II. were diſcovered by ſome labourers.

LYMINGTON, a borough town of Hampſhire in England, 97 miles ſouth-weſt of London. It ſtands about a mile from the channel running between the main land and the iſle of Wight; and has a harbour for veſſels of conſiderable burden. The tide flows near a mile above the town. It has a market on Saturdays, and two fairs in the year: and ſends two members to parliament.

LYMPH, a fine colourleſs fluid, ſeparated in the body from the maſs of blood, and contained in peculiar veſſels called *lymphatics*. See ANATOMY.

LYMPHÆA, were artificial caves or grottos amongſt the Romans, furniſhed with a great many tubes, canals, and various hydraulic apparatus, through which the water guſhed out upon the ſpectators unexpectedly whilſt they were admiring the beautiful arrangement of the ſhell-work in the grotto.

LYMPHATI, was a name given by the Romans to ſuch as were ſeized with madneſs. It is ſuppoſed to be uſed for *Nymphati*, becauſe the ancients imagined that every perſon who had the misfortune to ſee a Nymph was inſtantly ſtruck with phrenzy. *Lymphati* may indeed ſignify "madmen," as derived from *lympha*, "water," over which element the Nymphs were thought to preſide: But it appears moſt likely, that diſtracted people were called *lymphati*, from the circumſtance of madmen's being affected with the *hydrophobia* or dread of water after the bite of a mad dog; for this peculiarity, in caſes of canine madneſs, was not unknown to the Romans.

LYNCEUS, in fabulous hiſtory, one of the 50 ſons of Ægeus, married Hypermneſtra, one of the 50 daughters of Danaus. See HYPERMNESTRA.

LYNCEUS, in fabulous hiſtory, one of the Argonauts, who went with Jaſon in the expedition to obtain the golden fleece. He was of great uſe to the Argonauts, by enabling them to avoid the ſand banks and rocks they found in their way. The poets ſay, that Lynceus had ſo piercing a ſight, that it could not only penetrate to the bottom of the ſea, but even to hell. Some mythologiſts ſuppoſe, that this fable is taken from Lynceus's ſkill in obſerving the ſtars, and diſcovering the mines of gold and ſilver concealed in the earth.

LYNCURIUM, a ſtone thought to be the ſame with

with the tourmalin. The name is derived from λυγξ, "lynx," and ουρον, "urine."

LYNCURIUS LAPIS, a ſtone capable of producing muſhrooms.

In the Ephemerides of the Curious, we find mention made of a ſtone, ſo called by Dr John George Wolckamerus, who ſaw one in Italy, which never ceaſes to produce in a few days muſhrooms of an excellent flavour by the moſt ſimple and eaſy proceſs imaginable. "It is (ſays he) of the bigneſs of an ox's head, rough and uneven on its ſurface, and on which alſo are perceived ſome clefts and crevices. It is black in ſome parts, and in others of a lighter and grayiſh colour. Internally it is porous, and nearly of the nature of the pumice-ſtone, but much heavier; and it contains a ſmall piece of flint, which is ſo incorporated with it as to appear to have been formed at the ſame time the ſtone itſelf received its form. This gives room to judge, that thoſe ſtones have been produced by a fat and viſcid juice, which has the property of indurating whatever matter it filtrates into. The ſtone here ſpoken of, when it has been lightly covered with earth, and ſprinkled with warm water, produces muſhrooms of an exquiſite flavour, which are uſually round, ſometimes oval, and whoſe borders, by their inflexions and different curvities, repreſent in ſome meaſure human ears. The principal colour of theſe muſhrooms is ſometimes yellowiſh, and ſometimes of a bright purple; but they are always diſſeminated with different ſpots, of a deep orange colour, or red brown; and when theſe ſpots are recent, and ſtill in full bloom, they produce a very agreeable effect to the ſight. But what appears admirable is, that the part of the ſtalk which remains adhering to the ſtone, when the muſhroom has been ſeparated from it, grows gradually hard, and petrifies in time, ſo that it ſeems that this fungites reſtores to the ſtone the nutritive juice it received from it, and that it thus contributes to its increaſe." John Baptiſt Porta pretends, that this ſtone is found in ſeveral parts of Italy; and that it is not only to be met with at Naples, taken out of Mount Veſuvius, but alſo on Mount Pantherico, in the principality of Arellino; on Mount Garganus, in Apulia; and on the ſummits of ſome other very high mountains. He adds, that the muſhrooms which grow on thoſe ſorts of ſtones, and are uſually called *fungi lyncurii*, have the property of diſſolving and breaking the ſtone of the kidneys and bladder; and that, for this purpoſe, nothing more is required than to dry them in the ſhade, and being reduced to powder, to make the patient, faſting, take a ſufficient quantity of this powder in a glaſs of white wine, which will ſo cleanſe the excretory ducts of the urine, that no ſtones will ever after be collected in them. As to the form of thoſe muſhrooms, their root is ſtony, uneven, divided according to its longitudinal direction, and compoſed of fibres as fine as hairs, interwoven one with another. Their form, on firſt ſhooting out, reſembles a ſmall bladder, ſcarce then larger than the bud of a vine; and if in this ſtate they are ſqueezed between the fingers, an aqueous ſubacid liquor iſſues out. When they are at their full growth, their pedicle is of a finger's length, larger at top than at bottom, and becomes inſenſibly ſlenderer in proportion as it is nearer the earth. Theſe muſhrooms are alſo formed in an umbella, and variegated with an infinity of little ſpecks ſituated very near one another. They are ſmooth and even on the upper part, but underneath leafy like the common muſhrooms. Their taſte is likewiſe very agreeable, and the ſick are not debarred eating of them when they have been dreſſed in a proper manner. Curioſity having prompted ſome naturaliſts and phyſicians to ſubmit theſe ſtones to a chemical analyſis, in order to be more competent judges of the uſes they might be put to in medicine, there firſt came forth, by diſtillation, an inſipid water, and afterwards a ſpirituous liquor. The retort having been heated to a certain point, there aroſe an oil, which had nearly the ſmell and taſte of that of guaiacum; and a very acrid ſalt was extracted from the aſhes.

LYNN-REGIS, a town of Norfolk, in England, diſtant 98 miles from London. It is a handſome, large, well-built place, and ſends two members to parliament. It was a borough by preſcription in 1298. King John, on account of its adherence to him againſt the barons, made it a free borough, with large privileges. He appointed it a provoſt, and gave it a large ſilver cup of 73 ounces doubly gilt and enamelled, and a large ſilver ſword that is carried before the mayor; though this laſt, according to ſome, is Henry VIII.'s ſword, which he gave to the town when it came into his hands by exchange with the biſhop of Norwich; after which it was called King's Lynn, whereas before it was Biſhop's Lynn. Henry III. made it a mayor town, for its ſerving him againſt the barons. It has had 15 royal charters; and is governed by a mayor, high-ſteward, under-ſteward, recorder, 12 aldermen, and 18 common-council men. It has two churches, beſides St Nicholas, a chapel of eaſe to St Margaret's, a Preſbyterian and a Quakers meeting-houſe, with a bridewell or workhouſe, and ſeveral alms-houſes, and a free ſchool. In September 1741 the ſpires of its two churches were both blown down by a ſtorm of wind; and that of St Margaret's, which was 193 feet in height, having beat in the body of the church, it has been ſince rebuilt, towards which King George II. gave 1000l. and the late earl of Orford, then Sir Robert Walpole, 500l. This church was formerly an abbey, and afterwards one of the largeſt pariſh-churches in England. The town-houſe, called Trinity-hall, is a noble old fabric; and ſo is the Exchange, which is of free-ſtone, with two orders of columns. St Nicholas's chapel is very ancient, and reckoned one of the faireſt and largeſt of the kind in England. It has a bell-tower of free-ſtone, and an octagonal ſpire over it, both which together are 170 feet from the ground. There is a library in it that was erected by ſubſcription; and there is another at St Margaret's. Here have been formerly ſeveral monaſteries; but the only fabric remaining that belongs to any religious order is the Gray-friars ſteeple, a noted ſea-mark. The ſituation of this town, near the fall of the Ouſe into the ſea, after having received ſeveral other rivers, of which ſome are navigable, gives it an opportunity of extending its trade into eight different counties; by which many conſiderable cities and towns, viz. Peterborough, Ely, Stamford, Bedford, St Ives, Huntingdon, St Neot's, Northampton, Cambridge, St Edmundſbury, and the north parts of Bucks, as well as the inland parts of Norfolk and Suffolk, are ſupplied with heavy goods, not only from our own

Lynn-regis. produce, as coals and salt from Newcastle, but also of merchandise imported from abroad, especially wine; of which two articles, viz. coals and wine, this is the greatest port for importation of any place on all the eastern coast of England; and those wherein the Lynn merchants deal more largely than any town in England, except London, Bristol, and Newcastle. In return for this, Lynn receives back all the corn which the counties just mentioned produce, for exportation; and therefore sends more of it abroad than any port except Hull. The foreign trade of the merchants here, is very considerable, especially to Holland, Norway, and the Baltic, and also to Spain and Portugal; and formerly they drove a good trade to France, till it was turned off, by treaties on one hand, and by prohibitions, high duties, &c. on the other, to Spain and Portugal. The harbour is safe when ships are in it, but difficult to enter by reason of the many flats and shoals in the passage; which, however, are well buoyed, and good pilots are always ready. The town consists of about 2400 houses; and appears to have been very strong, by the ruins of the works demolished in the civil wars. St Ann's platform at the north end mounts 12 great guns, and commands all the ships passing near the harbour: and towards the land, besides the wall, there is a ditch. Four rivulets run through the town; and the tide of the Ouse, which is about as broad here as the Thames at London bridge, rises 20 feet perpendicular. In the great market-place a statue was erected in 1686 to the honour of King James II. There is another spacious market-place, adorned with a statue of King William III. and a fine cross with a dome and gallery round it, supported by 16 pillars. The market-house is of free-stone, supported by 16 columns, and is 70 feet high, erected on four steps, neatly adorned with statues, &c. Every first Monday in the month, the mayor, aldermen, preachers, &c. meet to hear and determine all controversies amicably, for preventing law-suits. This was first established in 1588, and is called *The Feast of Reconciliation*. The markets are on Tuesdays and Saturdays; and it has two fairs; one of which, beginning Feb. 14. lasts for a fortnight, and is called Lynn mart; the other is a cheese fair on Oct. 6. The adherence of this town to King John and to Henry VIII. as above mentioned, are not the only instances of its loyalty to its sovereigns; for, in the late civil wars, it held out for King Charles I. and sustained a formal siege of above 18,000 men of the parliament army for above three weeks; but, for want of relief, was obliged to surrender, and submit to the terms of paying 10s. a-head for every inhabitant, and a month's pay to the soldiers, to save the town from plunder. There are more gentry, and consequently more gaiety, in this town than in Yarmouth or even Norwich; there being such plenty of eatables and drinkables, that Spelman says, Ceres and Bacchus seem to have established their magazines at this place; the east side abounding with corn, sheep, rabbits, hares, &c. the west side with cheese, butter, black cattle, swans, and the wild-fowl common to marshes, besides the abundance of sea and river fish; so that he thinks there is no place in Great Britain, if in Europe, has such a variety in so small a compass of ground. At a small distance from the town, stands a mount, called the Lady's or Red Mount, which was once a chapel dedicated to the Virgin Mary, which was a resting-place for pilgrims on their way towards her convent at Walsingham. The king's staith-yard, or quay, where the greatest part of the imported wines is landed and put into large vaults, is a handsome square, with brick buildings, in the centre whereof is a statue of King James I. People pass hence into the fen-country, and over the famous washes into Lincolnshire in boats, which are often lost, by venturing out at an improper season and without guides.

Lynx || Lyonet.

LYNX. See FELIS, MAMMALIA *Index*.

LYON KING *of* ARMS. See KING; and LAW, N° clviii. 16.

This office is of great antiquity and respect in Scotland; and although the precise time of its institution is unknown, yet it must have been as early as the introduction of armorial figures as hereditary marks of gentility and distinction into this country, which was in the 12th century. His regalia are, a crown of gold, with a crimson velvet cap, a gold tassel, and an ermine lining: a velvet robe reaching to his feet, with the arms of the kingdom embroidered thereon before and behind in the proper tinctures; a triple row of gold chain round his neck, with an oval gold medal pendant thereto, on one side of which is the royal bearing, and on the other St Andrew with his cross enamelled in proper colours, and a baton of gold enamelled green, powdered with the badges of the kingdom. The lord lyon's rank is superior to that of any other king of arms, as he holds his office immediately from the sovereign by commission under the great seal; whereas the kings of arms in England are deputies to the earl marshal, and act under his authority. Formerly Scotland was divided into two provinces, the one on the north and the other on the south side of Forth; and these provinces were under the management of two deputies appointed by the lord lyon, to superintend the execution of all the business of his office. Before the Revolution, the lord lyon, at his admission into office, was most solemnly crowned by the sovereign or his commissioner, in presence of the nobility, the officers of state, and other great men, after a suitable sermon preached in the royal chapel; and his crown was of the same form with the imperial crown of the kingdom. On solemn occasions he wears the regalia above described; at all other times he wears the oval gold medal or badge on his breast, suspended by a broad green ribbon. He has the absolute disposal of all the offices in his own court, and of the heralds and pursuivants places. The messengers at arms throughout Scotland are also created by him, and are amenable to his jurisdiction. And the powers vested in him by his commission are the same with those of the sovereign in all matters relative to the marks of gentility.

LYONET, PETER, an ingenious naturalist, and member of several learned societies, was born at Maestricht, and was descended from a very ancient and respectable family of Lorrain. He had scarcely attained his seventh year before he displayed an uncommon strength and agility in all bodily exercises; but he was not less diligent in the improvement of his mind. Being placed at the Latin school, he learned chronology, and exercised himself in Latin, Greek, and French poetry, as also in Hebrew, logic, and the Cartesian physics. He was particularly fond of the study of languages, Lyonet.

guages, whereof he underſtood no leſs than nine, living and dead. Having entered the univerſity of Leyden, he ſtudied the Newtonian philoſophy, geometry, algebra, &c.; but his father (who was a clergyman), deſiring he ſhould attach himſelf to divinity, he reluctantly abandoned the former ſtudies, as his paſſion for them was not eaſily to be overcome. He at the ſame time applied himſelf to anatomy, and alſo to muſic and drawing. He began afterwards to practiſe ſculpture: and performed ſeveral pieces in wood, ſome of which are preſerved, and have been greatly admired by the artiſts. After this, he betook himſelf to drawing portraits of his friends from life; wherein, after three or four months practice, he became a great proficient. Having attained the degree of candidate in divinity, he reſolved to ſtudy law, to which he applied himſelf with ſo much zeal, that he was promoted at the end of the firſt year. Arrived at the Hague, he undertook the ſtudy of decyphering; and became ſecretary of the cyphers, tranſlator of the Latin and French languages, and patent-maſter to their High Mightineſſes. Meanwhile, having taken a ſtrong liking to the ſtudy of inſects, he undertook an hiſtorical deſcription of ſuch as are found about the Hague, and to that end collected materials for ſeveral volumes; and having invented a method of drawing adapted thereto, he enriched this work with a great number of plates, univerſally admired by all the connoiſſeurs who had ſeen them. In the year 1724 was printed at the Hague a French tranſlation of a German work, the 'Theology of Inſects,' by Mr Leſſer. Love of truth engaged Mr Lyonet to defer the publication of his above-mentioned deſcription, and to make ſome obſervations on that work, to which he has added two moſt beautiful plates, engraved from his deſigns. This performance cauſed his merit to be univerſally known and admired. The celebrated M. de Reaumur had the above tranſlation reprinted at Paris, not ſo much on account of the work itſelf as of Mr Lyonet's obſervations; and beſtowed on it, as did alſo many other authors, the higheſt encomiums. He afterwards executed drawings of the freſh water polypus for Mr Trembley's beautiful work, 1744. The ingenious Wandelaar had engraved the firſt five plates; when Mr Lyonet, who had never witneſſed this operation, concerned at the difficulties he experienced in getting the remaining eight finiſhed in the ſuperior ſtyle he required, reſolved to perform the taſk himſelf. He accordingly took a leſſon of one hour of Mr Wandelaar, engraved three or four ſmall plates, and immediately began upon the work himſelf, which he performed in ſuch a manner as drew on him the higheſt degree of praiſe, both from Mr Trembley and from many other artiſts, particularly the celebrated Van Gool; who declared that the performance aſtoniſhed not only the amateurs, but alſo the moſt experienced artiſts. In 1748 he was choſen member of the Royal Society of London. In 1749 he began (by mere chance) his amazing collection of horns and ſhells, which, according to the univerſal teſtimony of all travellers and amateurs who have viſited it, is at preſent the moſt beautiful, and certainly one of the moſt valuable, in Europe. In 1753 he became member of the newly-eſtabliſhed Dutch Society of Sciences at Haerlem; and in 1757, after the celebrated M. le Cat, profeſſor in anatomy and ſurgery, and member of almoſt all the principal ſocieties in Eurnpe, had ſeen Mr Lyonet's incomparable *Traité Anatomique de la Chenille qui ronge le Bois de Saule*, with the drawings belonging to it (which work was afterwards publiſhed), he was elected member of the Royal Academy of Sciences of Rome, whereof M. le Cat was perpetual ſecretary. After the publication of this treatiſe, he became, in 1760, member of the Royal Academy of Sciences of Berlin; in 1761, of the Imperial Academy of Naturaliſts; and, in 1762, of the Imperial Academy of Sciences at St Peterſburgh. In order to enable ſuch as might be deſirous of following him in his intricate and moſt aſtoniſhing diſcoveries reſpecting the ſtructure of this animal, Mr Lyonet publiſhed, in the Tranſactions of the Dutch Society of Sciences at Haerlem, a deſcription and a plate (as he alſo afterwards did in French at the beginning of his *Traité Anatomique*) of the inſtrument and tools he had invented for the purpoſe of diſſection, and likewiſe of the method he uſed to aſcertain the degree of ſtrength of his magnifying glaſſes. Notwithſtanding all this labour, which was conſiderably increaſed by the extenſive correſpondence which he for many years carried on with ſeveral learned and reſpectable perſonages, he ſtill found means to ſet apart a large proportion of his time (as he himſelf mentions it in his preface) for the immediate ſervice of his country; but was not fortunate enough (as appears by his writings) to get any other recompenſe for his exertions than ſorrow and diſappointment.—During the laſt fifteen or twenty years of his life, Mr Lyonet added to the valuable treaſure he had already collected of natural curioſities, a moſt ſuperb cabinet of paintings, conſiſting of more than 560 performances; among which are many of the moſt eminent works of the firſt Dutch maſters. He did this with a view to procure himſelf ſome amuſement during the latter part of his life, when old age and infirmities muſt weaken his powers, and ſet bounds to his activity. He had always indeed accuſtomed himſelf to employment, inſomuch that he has written ſome pieces of Dutch poetry; and this diſpoſition remained with him till within a fortnight of his death, when he was attacked with an inflammation in his breaſt, which, though apparently cured, was, in the end, the cauſe of his diſſolution. He died at the Hague in January 1789, aged 83 years, leaving behind him a moſt eſtimable character.

Lyonet ‖ Lyons.

LYONOIS, a large province of France; bounded on the north by Burgundy; on the eaſt, by Dauphiny, Breſſe, and the principality of Dombs; on the ſouth, by Vivarais and Velay; and on the weſt by Auvergne and a ſmall part of Bourbonnois. It comprehends Lower Lyonois, Beaujolois, and Forez; and it produces corn, wine, fruits, and more eſpecially excellent cheſnuts. The principal rivers are the Saone, the Rhone, and the Loire. Lyons is the capital town.

LYONS, a large, rich, handſome, ancient, and famous town of France, being the moſt conſiderable in the kingdom, next to Paris, with an archbiſhop's ſee, an academy of ſciences and belles lettres, and an academy of arts and ſciences ſettled here in 1736. It is ſeated in the centre of Europe, on the confluence of the

the rivers Rhone and Saone: on the ſide of it are two high mountains; and the mountain of St Sebaſtian ſerves as a bulwark againſt the north winds, which often blow here with great violence. It contains about 150,000 inhabitants; and the houſes, in general, are high and well built. It has ſix gates, and as many ſuburbs. The town-houſe, the arſenal, the amphitheatre built by the ancient Romans, the hoſpital, and the numerous palaces, are worthy of a traveller's attention. The cathedral is a ſuperb ſtructure, and the canons that compoſe the chapter are all perſons of diſtinction. It is a place of very great trade, which is extended through Europe. It derives vaſt advantages from the rivers near it; and is ſituated in E. Long. 4. 55. N. Lat. 45. 46. Lyons was the ſcene of ſome the horrid tranſactions of the French revolution. See France.

LYRA, a ſpecies of fiſh. See Callyonimus, Ichthyology *Index*.

Lyra, in *Aſtronomy*, a conſtellation in the northern hemiſphere. The number of its ſtars, in Ptolemy's catalogue, is ten; in Tycho's eleven; in Hevelius's ſeventeen; and in the Britannic catalogue twenty one.

LYRE, a muſical inſtrument of the ſtringed kind, much uſed by the ancients.

Concerning the number of ſtrings with which this inſtrument was furniſhed, there is great controverſy. Some aſſert it to be only three; and that the ſounds of the two remote were acute, and that of the intermediate one a mean between thoſe two extremes; that Mercury, the inventor, reſembled thoſe three chords to as many ſeaſons of the year, which were all that the Greeks reckoned, namely, ſummer, winter, and ſpring: aſſigning the acute to the firſt, the grave to the ſecond, and the mean to the third.

Others aſſert that the lyre had four ſtrings; that the interval between the firſt and the fourth was an octave; that the ſecond was a fourth from the firſt, and the fourth the ſame diſtance from the third, and that from the ſecond to the third was a tone.

Another claſs of writers contend that the lyre of Mercury had ſeven ſtrings. Nicomachus, a follower of Pythagoras, and the chief of them, gives the following account of the matter: "The lyre made of the ſhell was invented by Mercury; and the knowledge of it, as it was conſtructed by him of ſeven ſtrings, was tranſmitted to Orpheus: Orpheus taught the uſe of it to Thamyris and Linus; the latter of whom taught it to Hercules, who communicated it to Amphion the Theban, who built the ſeven gates of Thebes to the ſeven ſtrings of the lyre." The ſame author proceeds to relate, "That Orpheus was afterwards killed by the Thracian women; and that they are reported to have caſt his lyre into the ſea, which was afterwards thrown up at Antiſſa, a city of Leſbos: that certain fiſhers finding it, they brought it to Terpander, who carried it into Egypt, exquiſitely improved, and, ſhowing it to the Egyptian prieſts, aſſumed to himſelf the honour of its invention."

This difference among authors ſeem to have ariſen from their confounding together the Egyptian and the Grecian Mercuries.—The invention of the primitive lyre with three ſtrings was due to the firſt Egyptian Hermes, as mentioned under that article.—The lyre attributed to the Grecian Mercury is deſcribed by almoſt all the poets to be an inſtrument of ſeven ſtrings †. Vincenzio Galilei has collected the various opinions of the ſeveral Greek writers who have mentioned the invention of the chelys or teſtudo; and the late Mr Spence has done the ſame in a very circumſtantial but ludicrous manner. "Horace talks of Mercury as a wonderful muſician, and repreſents him with a lyre. There is a ridiculous old legend relating to this invention, which informs us, that Mercury, after ſtealing ſome bulls from Apollo, retired to a ſecret grotto, which he uſed to frequent, at the foot of a mountain in Arcadia. Juſt as he was going in, he found a tortoiſe feeding at the entrance of his cave: he killed the poor creature, and perhaps ate the fleſh of it. As he was diverting himſelf with the ſhell, he was mightily pleaſed with the noiſe it gave from its concave figure. He had poſſibly been cunning enough to find out, that a thong pulled ſtrait and faſtened at each end, when ſtruck with the finger, made a ſort of muſical ſound. However that was, he went immediately to work, and cut ſeveral thongs out of the hides he had lately ſtolen, and faſtened them as tight as he could to the ſhell of this tortoiſe; and, in playing with them, made a new kind of muſic with them to divert himſelf in his retreat." This, conſidered only as an account of the firſt invention of the lyre, is not altogether ſo unnatural.

† See *Mercury*.

The moſt ancient repreſentations of this inſtrument agree very well with the account of its invention: the lyre, in particular on the old celeſtial globes, was repreſented as made of one entire ſhell of a tortoiſe; and that of Amphion in the celebrated group of the Dirce or Toro, in the Farneſe palace at Rome, which is of Greek ſculpture, and very high antiquity, is figured in the ſame manner.

There have, however, been many other claimants to the ſeven-ſtringed lyre. For though Mercury invented this inſtrument in the manner already related, it is ſaid he afterwards gave it to Apollo, who was the firſt that played upon it with method, and made it the conſtant companion of poetry. According to Homer's account of this tranſaction, in his hymn to Mercury, it was given by that god to Apollo, as a peace-offering and indemnification for the oxen which he had ſtolen from him:

> To Phœbus Maia's ſon preſents the lyre,
> A gift intended to appeaſe his ire,
> The god receives it gladly, and eſſays
> The novel inſtrument a thouſand ways;
> With dext'rous ſkill the plectrum wields; and ſings
> With voice accordant to the trembling ſtrings,
> Such ſtrains as gods and men approv'd, from whence
> The ſweet alliance ſprung of ſound and ſenſe.

Diodorus informs us, that Apollo ſoon repenting of the cruelty with which he had treated Marſyas in conſequence of their muſical conteſt, broke the ſtrings of the lyre, and by that means put a ſtop for a time to any further progreſs in the practice of that new inſtrument. "The Muſes (adds he) afterwards added to this inſtrument the ſtring called *meſe;* Linus, that of *lichanos;* and

Lyre.

and Orpheus and Thamyris, those strings which are named *hypate* and *parhypate* (A).

Again, Many ancient and respectable authors tell us, that, before the time of Terpander, the Grecian lyre had only four strings; and, if we may believe Suidas, it remained in this state 856 years, from the time of Amphion, till Terpander added to it three new strings, which extended the musical scale to a heptachord, or seventh, and supplied the player with two conjoint tetrachords. It was about 150 years after this period, that Pythagoras is said to have added an eighth string to the lyre, in order to complete the octave, which consisted of two disjoint tetrachords.

Boetius gives a different history of the scale, and tells us, that the system did not long remain in such narrow limits as a tetrachord. Chorœbus, the son of Athis, or Atys, king of Lydia, added a fifth string; Hyagnis, a sixth; Terpander, a seventh; and at length Lychaon of Samos, an eighth. But all these accounts are irreconcilable with Homer's hymn to Mercury, where the chelys, or testudo, the invention of which he ascribes to that god, is said to have had seven strings. There are many claimants among the musicians of ancient Greece to the strings that were afterwards added to these, by which the scale, in the time of Aristoxenus, was extended to two octaves. Athenæus, more than once, speaks of the nine-stringed instrument; and Ion of Chios, a tragic and lyric poet and philosopher, who first recited his pieces in the 82d Olympiad, 452 B. C. mentions, in some verses quoted by Euclid, the ten-stringed lyre; a proof that the third conjoint tetrachord was added to the scale in his time, which was about 50 years after Pythagoras is supposed to have constructed the octachord.

The different claimants among the Greeks to the same musical discoveries, only prove that music was cultivated in different countries, and that the inhabitants of each country invented and improved their own instruments, some of which happening to resemble those of other parts of Greece, rendered it difficult for historians to avoid attributing the same invention to different persons. Thus the single flute was given to Minerva and to Marsyas; the syrinx or fistula, to Pan and to Cybele; and the lyre or cithara, to Mercury, Apollo, Amphion, Linus, and Orpheus. Indeed, the mere addition of a string or two to an instrument without a neck, was so obvious and easy, that it is scarce possible not to conceive many people to have done it at the same time.

Lyre.

With respect to the form of the ancient lyre, as little agreement is to be found among authors as about the number of strings. The best evidences concerning it, are the representations of that instrument in the hands of ancient statues, bas-reliefs, &c. See Plate CCXCVIII. where,

Fig. 1. is a representation of the testudo, or lyre of Amphion, in front, as it appears on the base of the celebrated Toro Farnese at Rome. This admirable work, consisting of four figures bigger than the life, besides the toro or bull, was found in Caracalla's baths, where the Farnese Hercules was likewise discovered: and, except the Laocoon, is the only piece of Greek sculpture mentioned by Pliny that is now remaining. The two projections near the bottom, seem to have been fastenings for the strings, and to have answered the purpose of tail-pieces in modern instruments.

2. The lyre held by Terpsichore, in the picture of that muse dug out of Herculaneum.

3. The Abyssinian testudo, or lyre in use at present in the province of Tigre, from a drawing of Mr Bruce, communicated to Dr Burney. "This instrument (says he) has sometimes five, sometimes six, but most frequently seven strings, made of the thongs of raw sheep or goat skins, cut extremely fine, and twisted; they rot soon, are very subject to break in dry weather, and have scarce any sound in wet. From the idea, however, of this instrument being to accompany and sustain a voice, one would think that it was better mounted formerly. "The Abyssinians have a tradition, that the sistrum, lyre, and tambourine, were brought from Egypt into Ethiopia, by Thot, in the very first ages of the world. The flute, kettle-drum, and trumpet, they say, were brought from Palestine, with Menelek, the son of their queen of Saba by Solomon, who was their first Jewish king.

"The lyre in Amharic is called *beg*, 'the sheep; in Ethiopic it is called *mesinko;* the verb *sinko* signifies to strike strings with the fingers: no plectrum is ever used in Abyssinia; so that mesinko, being literally interpreted, will signify the 'stringed instrument played upon with the fingers.'

"The sides which constitute the frame of the lyre, were anciently composed of the horns of an animal of the goat kind, called *agazen*, about the size of a small cow, and

(A) It has been already related, that the lyre invented by the Egyptian Mercury had but three strings; and, by putting these two circumstances together, Dr Burney observes, we may perhaps acquire some knowledge of the progress of music, or, at least, of the extension of its scale, in the highest antiquity.

Mese, in the Greek music, is the fourth sound of the second tetrachord of the great system, and first tetrachord invented by the ancients, answering to our A, on the fifth line in the base. If this sound then was added to the former three, it proves two important points; first, that the most ancient tetrachord was that from E in the base to A; and that the three original strings in the Mercurian and Apollonian lyre were tuned E, F, G, which the Greeks called *Hypate Meson*, *Parhypate Meson*, *Meson Diatonos*. The addition therefore of *Mese* to these, completed the first and most ancient tetrachord, E, F, G, A.

The string *lichanos*, then, being added to these, and answering to our D on the third line in the base, extended the compass downwards, and gave the ancient lyre a regular series of five sounds in the Dorian mode, the most ancient of all the Greek modes; and the two strings call *Hypate* and *Parhypate*, corresponding with our B and C in the base, completed the heptachord, or seven sounds, B, C, D, E, F, G, A, a compass that received no addition till after the time of Pindar, who calls the instrument then in use the *seven-tongued lyre*.

and common in the province of Tigre. I have ſeen ſeveral of theſe inſtruments very elegantly made of ſuch horns, which nature ſeems to have ſhaped on purpoſe. Some of the horns of an African ſpecies of this animal may be ſeen in M. Buffon's hiſtory of the king of France's cabinet. They are bent, and leſs regular than the Abyſſinian; but after fire-arms became common in the province of Tigre, and the woods were cut down, this animal being more ſcarce, the lyre has been made of a light red wood; however, it is always cut into a ſpiral twiſted form, in imitation of the ancient materials of which the lyre was compoſed. The drawing I ſend you was one of theſe inſtruments made of wood.

"The kingdom of Tigre, which is the largeſt and moſt populous province of Abyſſinia, and was during many ages the ſeat of the court, was the firſt which received letters, and civil religious government; it extended once to the Red ſea: various reaſons and revolutions have obliged the inhabitants to reſign their ſea coaſt to different barbarous nations, Pagan and Mahometan: while they were poſſeſſed of it, they ſay that the Red ſea furniſhed them with tortoiſe-ſhells, of which they made the bellies of their lyres, as the Egyptians did formerly, according to Apollodorus and Lucian; but having now loſt that reſource, they have adopted in its place a particular ſpecies of gourd, or pumpkin, very hard and thin in the bark, ſtill imitating with the knife the ſquares, compartments, and figure of the ſhell of the tortoiſe.

"The lyre is generally from three feet to three feet ſix inches high; that is, from a line drawn through the point of the horns, to the lower part of the baſe of the ſounding board. It is exceedingly light, and eaſy of carriage, as an inſtrument ſhould naturally be in ſo rugged and mountainous a country.

"When we conſider the parts which compoſe this lyre, we cannot deny it the earlieſt antiquity. Man in his firſt ſtate was a hunter and a fiſher, and the oldeſt inſtrument was that which partakes moſt of that ſtate. The lyre, compoſed of two principal pieces, owes the one to horns of an animal, the other to the ſhell of a fiſh.

"It is probable, that the lyre continued with the Ethiopians in this rude ſtate as long as they confined themſelves to their rainy, ſteep, and rugged mountains; and afterwards, when many of them deſcended along the Nile into Egypt, its portability would recommend it in the extreme heats and wearineſs of their way. Upon their arrival in Egypt, they took up their habitation in caves, in the ſides of mountains, which are inhabited to this day. Even in theſe circumſtances, an inſtrument larger than the lyre muſt have been inconvenient and liable to accidents in thoſe caverns; but when theſe people increaſed in numbers and courage, they ventured down into the plain, and built Thebes. Being now at their eaſe, and in a fine climate, all nature ſmiling around them, muſic and other arts were cultivated and refined, and the imperfect lyre was extended into an inſtrument of double its compaſs and volume. The ſize of the harp could be now no longer an objection; the Nile carried the inhabitants every-where eaſily, and without effort; and we may naturally ſuppoſe in the fine evenings of that country, that the Nile was the favourite ſcene upon which this inſtrument was practiſed; at leaſt the ſphinx and lotus upon its head, ſeem to hint that it was ſomeway connected with the overflowings of that river." See Harp.

4. An Etruſcan lyre, with ſeven ſtrings, in the collection of Etruſcan, Greek and Roman antiquities, publiſhed from the cabinet of the Hon. Sir William Hamilton, Vol I. Naples 1766. Plate CIX. With reſpect to this inſtrument, it is worthy of obſervation, that though the vaſe upon which it is repreſented is of ſuch indiſputable and remote antiquity, the tail-piece, bridge, belly, and ſound-holes, have a very modern appearance, and manifeſt a knowledge in the conſtruction of muſical inſtruments among the Etruſcans ſuperior to that of the Greeks and Romans in much latter times. The lower part of the inſtrument has much the appearance of an old baſs-viol, and it is not difficult to diſcover in it more than the embryo of the whole violin family. The ſtrings lie round, as if intended to be played on with a bow; and even the croſs lines on the tail-piece are ſuch as we frequently ſee on the tail-pieces of old viols.

5. The Tripodian lyre of Pythagoras the Zacynthian, from a bas-relief in the Maffei palace at Rome repreſenting the whole choir of the muſes. Athenæus gives the following account of this extraordinary inſtrument, Lib. XIV. cap. xv. p. 637. Many ancient inſtruments are recorded (ſays Artemon), of which we have ſo little knowledge, that we can hardly be certain of their exiſtence; ſuch as the tripod of Pythagoras the Zacynthian, which, on account of its difficulty, continued in uſe but a ſhort time. It reſembled in form the Delphic tripod, whence it had its name. The legs were equidiſtant, and fixed upon a moveable baſe that was turned by the foot of the player: the ſtrings were placed between the legs of the ſtool; the vaſe at the top ſerved for the purpoſe of a ſound-board, and the ſtrings of the three ſides of the inſtrument were tuned to three different modes, the Doric, Lydian, and Phrygian. The performer ſat on a chair made on purpoſe: ſtriking the ſtrings with the fingers of the left hand, and uſing the plectrum with the right, at the ſame time turning the inſtrument with his foot to whichever of the three modes he pleaſed: ſo that by great practice he was enabled to change the modes with ſuch velocity, that thoſe who did not ſee him would imagine they heard three different performers playing in three different modes. After the death of this admirable muſician, no other inſtrument of the ſame kind was ever conſtructed."

6. A lyre in the famous ancient picture dug out of Herculaneum, upon which Chiron is teaching the young Achilles to play. See Chiron.

LYRIC poetry, was ſuch as the ancients ſung to the lyre or harp.—It was originally employed in celebrating the praiſes of gods and heroes, and its characteriſtic was ſweetneſs. Who was the author of it is not known. It was much cultivated by the Greeks: and Horace was the firſt who attempted it in the Latin language. Anacreon, Alcæus, Steſichorus, Sappho, and Horace, were the moſt celebrated lyric poets of antiquity.

LYRODI, among the ancients, a kind of muſicians who played on the lyre, and ſung at the ſame time. This

This appellation was alfo given to fuch as made it their employment to fing lyric poems compofed by others.

LYS, or Lis. See Lis.

Lys, the name of a meafure ufed by the Chinefe in eftimating diftances. Two hundered lys make 60 geographical miles, which are equal to one degree.

LYSANDER, a famous Spartan general. See Sparta.

LYSANDRIA, a Samian feftival, celebrated with games and facrifices in honour of the Lacedemonian general Lyfander. It was anciently called *herea*: but this name the Samians abolifhed by a public decree.

LYSIARCH, an ancient magiftrate, who fuperintended the facred games, and prefided in matters of religion in the province of Lycia. He was created in a council confifting of deputies from all the provincial cities, in number 23. The lyfiarchs were both heads of the council and pontiffs of the province.

LYSIAS, an ancient Grecian orator, was born at Syracufe in the 80th Olympiad. At 15, he went to Thurion, a colony of the Athenians; and when grown up, affifted in the adminiftration of the government there many years. When about 47 years of age, he returned to Athens; whence, being afterwards banifhed by the 30 tyrants, he went to Megara. Upon his return, Thrafybulus would have had him employed again in ftate matters; but this not taking place, he fpent the remainder of his life as a private man. He was very familiar with Socrates, and other illuftrious philofophers. He profeffed to teach the art of fpeaking; not that he pleaded at the bar himfelf, but he fupplied others with fpeeches. "Fuit Lyfias in caufis forenfibus non verfatus (fays Cicero), fed egregie fubtilis fcriptor atque elegans," &c. Quintilian calls him, "fubtilis atque elegans, et quo nihil, fi oratorio fatis fit docere, quæras perfectius. Nihil enim eft inane, nihil arceffitum; puro tamen fonti, quam magno flumini, proprior." Plutarch and Photius relate, that 425 orations were formerly exhibited under the name of Lyfias; of which 34 only are now extant. The beft edition of them is by Dr John Taylor at London, 1739, 4to; Cambridge, 1740, 8vo.

LYSIMACHIA, loosestrife, a genus of plants belonging to the pentandria clafs; and in the natural method ranking under the 20th order, *Rotaceæ*. See Botany *Index*.

LYSIPPUS, a celebrated Greek ftatuary, was born at Sicyone, and firft followed the bufinefs of a lockfmith, which he quitted in order to practife painting: But he afterwards applied himfelf entirely to fculpture; in which he acquired an immortal reputation, and made a great number of ftatues that were the admiration of the people of Athens and Rome. His grand ftatue of the Sun reprefented in a car drawn by four horfes, was worfhipped at Rhodes. He made feveral ftatues of Alexander and his favourites, which were brought to Rome by Metellus after he had reduced the Macedonian empire; and the ftatue of a man wiping and anointing himfelf after bathing, being particularly excellent, was placed by Agrippa before his baths in that city. He lived in the time of Alexander the Great, about 334 B. C.; and left three fons, who were all famous ftatuaries.

LYTHRUM, purple loosestrife, a genus of plants belonging to the decandria clafs; and in the natural method ranking under the 17th order, *Calycanthemæ*. See Botany *Index*.

LYTTELTON, Edward, Lord Lyttelton, keeper of the great feal in the reign of Charles I. was eminent for his probity and his moderation at the commencement of that monarch's difputes with his fubjects. Without forfeiting his fidelity to the king, he preferved the efteem of the parliament till 1644, when he was made colonel of a regiment in the king's army at York. He died in 1645. Befides feveral of his fpeeches which have been printed, he wrote reports in the common pleas and exchequer, printed at London in 1683, in folio; feveral arguments and difcourfes, &c.

Lyttelton, *George Lord*, eldeft fon of Sir Thomas Lyttelton, Bart. defcended from the great judge Lyttelton, was born in 1700, at feven months; and the midwife fuppofing him to be dead, threw him carelefsly into the cradle; where, had not fome figns of life been taken notice of by one of the attendants, he might never have recovered. He received the elements of his education at Eaton-fchool, where he fhowed an early inclination to poetry. His paftorals and fome other light pieces were originally written in that feminary of learning; from whence he was removed to the univerfity of Oxford, where he purfued his claffical ftudies with uncommon avidity, and fketched the plan of his Perfian Letters; a work which afterwards procured him great reputation, not only from the elegance of the language in which they were compofed, but from the excellent obfervations they contained on the manners of mankind.

In the year 1728, he fet out on the tour of Europe; and, on his arrival at Paris, accidentally became acquainted with the honourable Mr Poyntz, then our minifter at the court of Verfailles; who was fo ftruck with the extraordinary capacity of our young traveller, that he invited him to his houfe, and employed him in many political negociations, which he executed with great judgement and fidelity.

Mr Lyttelton's conduct, while on his travels, was a leffon of inftruction to the reft of his countrymen. Inftead of lounging away his hours at the coffee-houfes frequented by the Englifh, and adopting the fafhionable follies and vices of France and Italy, his time was paffed alternately in his library and in the fociety of men of rank and literature. In this early part of his life, he wrote a poetical epiftle to Dr Ayfcough, and another to Mr Pope, which fhow fingular tafte and correctnefs.

After continuing a confiderable time at Paris with Mr Poyntz, who, to ufe his own words, behaved like a fecond father to him, he proceeded to Lyons and Geneva; and from thence to Turin, where he was honoured with great marks of friendfhip by his Sardinian majefty. He then vifited Milan, Venice, Genoa, and Rome, where he applied himfelf clofely to the ftudy of the fine arts; and was, even in that celebrated metropolis, allowed a perfect judge of painting, fculpture, and architecture.

During his continuance abroad, he conftantly correfponded

Lyttelton. refponded with Sir Thomas, his father. Several of his letters are yet remaining, and place his filial affection in a very diftinguifhed light. He foon after returned to his native country, and was elected reprefentative for the borough of Okehampton in Devonfhire; and behaved fo much to the fatisfaction of his conftitnents, that they feveral times re-elected him for the fame place without putting him to the leaft expence.

About this period, he received great marks of friendfhip from Frederic prince of Wales, father of his prefent majefty; and was, in the year 1737, appointed principal fecretary to his royal highnefs, and continued in the ftricteft intimacy with him till the time of his death. His attention to public bufinefs did not, however, prevent him from exercifing his poetical talent. A moft amiable young lady, Mifs Fortefcue, infpired him with a paffion, which produced a number of little pieces, remarkable for their tendernefs and elegance; and he had a happy facility of ftriking out an extempore compliment, which obtained him no fmall fhare of reputation. One evening being in company with Lord Cobham and feveral of the nobility at Stowe, his lordfhip mentioned his defign of putting up a buft of Lady Suffolk in his beautiful gardens; and, turning to Mr Lyttelton, faid, "George, you muft furnifh me with a motto for it." "I will, my lord," anfwered Mr Lyttelton; and directly produced the following couplet:

Her wit and beauty for a court were made,
But truth and goodnefs fit her for a fhade.

When Mr Pitt, the late earl of Chatham, loft his commiffion in the guards, in confequence of his fpirited behaviour in parliament, Mr Lyttelton was in waiting at Leicefter-houfe, and, on hearing the circumftance, immediately wrote thefe lines:

Long had thy virtue mark'd thee out for fame,
Far, far fuperior to a cornet's name;
This generous Walpole faw, and griev'd to find
So mean a poft difgrace that noble mind;
The fervile ftandard from thy free-born hand
He took, and bade thee lead the patriot band.

In the year 1742, he married Lucy, the daughter of Hugh Fortefcue, Efq. of Filleigh in the county of Devon, the lady above-mentioned, whofe exemplary conduct, and uniform practice of religion and virtue, eftablifhed his conjugal happinefs upon the moft folid bafis.

In 1744, he was appointed one of the lords commiffioners of the treafury; and, during his continuance in that ftation, conftantly exerted his influence in rewarding merit and ability. He was the friend and patron of the late Henry Fielding, James Thomfon author of the Seafons, Mr Mallet, Dr Young, Mr Hammond, Mr Weft, Mr Pope, and Voltaire. On the death of Thomfon, who left his affairs in a very embarraffed condition, Mr Lyttelton took that poet's fifter under his protection. He revifed the tragedy of Coriolanus, which that writer had not put the laft hand to; and brought it out at the theatre-royal, Covent-garden, with a prologue of his own writing, in which he fo affectingly lamented the lofs of that delightful bard, that not only Mr Quin, who fpoke the lines, but almoft the whole audience, fpontaneoufly burft into ears.

In the beginning of the year 1746, his felicity was interrupted by the lofs of his wife, who died in the 29th year of her age; leaving him one fon, Thomas, the late Lord Lyttelton; and a daughter, Lucy, who fome time fince married Lord Vifcount Valentia. The remains of his amiable lady were depofited at Over-Arley in Worcefterfhire; and an elegant monument was erected to her memory in the church of Hagley, which contains the following infcription written by her hufband:

Made to engage all hearts, and charm all eyes:
Tho' meek, magnanimous; tho' witty, wife;
Polite, as all her life in courts had been;
Yet good, as fhe the world had never feen:
The noble fire of an exalted mind,
With gentleft female tendernefs combin'd.
Her fpeech was the melodious voice of love,
Her fong the warbling of the vernal grove.
Her eloquence was fweeter than her fong,
Soft as her heart, and as her reafon ftrong.
Her form each beauty of her mind exprefs'd,
Her mind was virtue by the Graces drefs'd.

Befides thefe beautiful lines, Mr Lyttelton wrote a monody on the death of his lady, which will be remembered while conjugal affection and a tafte for poetry exift in this country.

His mafterly obfervations on the converfion and apoftlefhip of St Paul, were written at the defire of Gilbert Weft, Efq. in confequence of Mr Lyttelton's afferting, that, befide all the proofs of the Chriftian religion, which might be drawn from the prophecies of the Old Teftament, from the neceffary connection it has with the whole fyftem of the Jewifh religion, from the miracles of Chrift, and from the evidence given of his refurrection by all the other apoftles, he thought the converfion of St Paul alone, duly confidered, was of itfelf a demonftration fufficient to prove Chriftianity to be a divine revelation. Mr Weft was ftruck with the thought: and affured his friend, that fo compendious a proof would be of great ufe to convince thofe unbelievers that will not attend to a longer feries of arguments; and time has fhown he was not out in his conjecture, as the tract is efteemed one of the beft defences of Chriftianity which has hitherto been publifhed.

In 1754, he refigned his office of lord of the treafury, and was made cofferer to his majefty's houfehold, and fworn of the privy-council: previous to which, he married, a fecond time, Elizabeth daughter of Field-marfhal Sir Robert Rich; whofe indifcreet conduct gave him great uneafinefs, and from whom he was feparated, by mutual confent, a few years after his marriage.

After being appointed chancellor and under treafurer of the court of exchequer, he was, by letters-patent dated the 19th of November 1757, 31 Geo. II. created a peer of Great Britain, by the ftyle and title of *Lord Lyttelton, baron of Frankley, in the county of Worcefter*. His fpeeches on the Scotch and mutiny bills in the year 1747, on the Jew bill in 1753, and on the privilege of parliament in 1763, fhowed found judgement, powerful eloquence, and inflexible integrity.

Lyttelton.

grity. During the last ten years he lived chiefly in retirement, in the continual exercise of all the virtues which can ennoble private life. His last work was Dialogues of the Dead, in which the morality of Cambray and the spirit of Fontenelle are happily united.

He was suddenly seized with an inflammation of the bowels, in the middle of July 1773, at his seat at Hagley; which terminated in his death, on the 22d of that month. His last moments were attended with unimpaired understanding, unaffected greatness of mind, calm resignation, and humble but confident hopes in the mercy of God. As he had lived universally esteemed, he died lamented by all parties. A complete collection of his works has been published since his decease, by his nephew George Ayscough, Esq.

M.

M || Mabillon.

M, a liquid consonant, and the twelfth letter in the alphabet.

It has one unvaried sound, and is pronounced by striking the upper lip against the lower; in which the pronunciation of this letter agrees with that of *b*; the only difference between the two consisting in a little motion made in the nose in pronouncing *m*, and not in *b*: whence it happens that those who have taken cold, for *m* ordinarily pronounce *b*; the nose in that case being disabled from making the necessary motion.

All consonants are formed with the aid of vowels; in *em* the vowel precedes, in *be* it follows; and *m* is never mute.

Quintilian observes, that the *m* sometimes ends Latin words but never Greek ones; the Greeks always changing it in that case into *n*, for the sake of the better sound.

M is also a numeral letter, and among the ancients was used for a thousand; according to the verse,

M caput est numeri, quem scimus mille teneri.

When a dash is added to the top of it, as $\overline{\text{M}}$; it signifies a thousand times a thousand.

M, as an abbreviature, stands for Manlius, Marcus, Martius, and Mucius: M. A. signifies *magister artium*, or master of arts; MS. manuscript, and MSS. manuscripts.

M, in astronomical tables, and other things of that kind, is used for *meridional* or southern; and sometimes for *meridian* or mid-day.

M, in medicinal prescription, is frequently used to signify a maniple or handful; and it is sometimes also put at the end of a recipe, for *misce* "mingle;" or for *mixtura* "a mixture." Thus *m. f. julapium*, signifies "mix and make a julep."

M, in *Law*, the brand or stigma of a person convicted of manslaughter, and admitted to the benefit of his clergy. It is to be burnt on the brawn of his left thumb.

MAAT, John. See Blankof.

MABILLON, John, a very learned writer of France in the 17th century, was born at Perremonte, on the frontiers of Champagne, in 1632. He was educated in the university of Rheims, and afterwards entered into the abbey of the Benedictines of St Remy. In the year 1663, he was appointed keeper of the treasures and monuments of France at St Dennis: but having unfortunately broke a looking glass there, which was pretended to have belonged to Virgil, he desired leave of his superiors to quit an employment which frequently obliged him to tell things he did not believe. Next year he went to Paris; and was very serviceable to Father d'Acheri, who was desirous of having some young monk who could assist him in compiling his *Spicilegium*. This made him known. Soon after, the congregation of St Maur having formed a design of publishing new editions of the fathers, revised from the MSS. in the libraries of the Benedictines, Mabillon was charged with the edition of St Bernard, which he prepared with extraordinary diligence. After that, he published many other works, which are evidences of his vast capacity and industry. In 1682, he was employed by Mr Colbert in examining some ancient titles relating to the royal family. The year following he sent him into Germany, to search the archives and libraries of the ancient abbeys, for what was most curious and proper to illustrate the history of the church in general, and that of France in particular. He has published an account of this journey. In 1685, he undertook another journey into Italy, by order of the king of France; and returned the year following with a very noble collection. He placed in the king's library above 3000 volumes of rare books, printed and in MSS. and composed two volumes of the pieces which he had discovered in that country. He was highly esteemed for his virtues as well as his learning.

Macaco || Macarians.

MACACO, or Macauco. See Lemur, Mammalia *Index*.

MACAO, a town of China, in the province of Canton, seated in an island at the mouth of the river Tae. The Portuguese have been in possession of the harbour for 150 years. Formerly they had a great trade here; but now they have only a fort with a small garrison. The houses are built after the European manner; and there is a Chinese mandarin, as well as a Portuguese governor, to take care of the town and the neighbouring country. E. Long. 112. 13. N. Lat. 22. 12.

Macao. See Psittacus, Ornithology *Index*.

MACARIANS, in ecclesiastical history, the followers of Macarius, an Egyptian monk, who was distinguished towards the close of the fourth century for his sanctity and virtue. In his writings there are some superstitious tenets, and also certain opinions that seem tainted with Origenism. The name has been also applied to those who adopted the sentiments of Macarius a native of Ireland, who about the close of the ninth century, propagated in France the error afterwards maintained by Averrhoes, that one individual intelligence or soul performed the spiritual and rational functions in all the human race.

MACARONI. See FOLENGIO, and the next article.

MACARONIC, or MACARONIAN, a kind of burlesque poetry, consisting of a jumble of words of different languages, with words of the vulgar tongue Latinized; and Latin words modernized. *Macaroni* among the Italians, as has been observed by Cælius Rhodiginus, signifies *a coarse clownish man*; and because this kind of poetry is patched out of several languages, and full of extravagant words, &c. the Italians, among whom it had its rise, gave it the name of *macaronian* or *macaronic* poetry. Others choose to derive it *à macaronibus*, from *macaroons*, a kind of confection made of meal not boulted, sweet almonds, sugar, and the white of eggs, accounted a great dainty among the country people in Italy; which, from their being composed of various ingredients, occasioned this kind of poetry, which consists of Latin, Italian, Spanish, French, English, &c. to be called by their name.

Example.—A bold fellow in the *macaronic* style, says,

Ensilavi omnes scadrones et regimandos, &c.

Another example:

Archelos pistoliferos furiamque manantum,
Et grandem esmeutam quæ inopinum facta ruelle est:
Toxinumque alto troublantem corda clochero, &c.

Theoph. Folengius, a Benedictine monk of Mantua, was the first who invented, or at least cultivated, this kind of verse. See FOLENGIO.

The best pieces of this kind are, the *Baldus* of Folengio, and *Macaronis Forza* by Stefonio a Jesuit, among the Italians; and the *Reatus veritabilis, super terribili esmeuta paisanarum de Ruellis*; among the French. The famous Rabelais first transferred the *macaronic* style out of the Italian verse into French prose: and on the model thereof formed some of the best things in his *Pantagruel*. We have little in English in the *macaronian* way; nothing scarce, but some little loose pieces collected in Camden's remains. But the Germans and Netherlanders have had their *macaronic* poets; witness the *Certamen Catholicum cum Calvinistis*, of one Martinius Hamconius Frisius, which contains about 1200 verses, all the words whereof begin with the letter *C*.

MACARSKA, a town of Dalmatia, and capital of Primogria, with a pretty good harbour, and a bishop's see, seated on the gulf of Venice. E. Long. 17. 57. N. Lat. 43. 42.

MACASSAR, a considerable kingdom of the island of Celebes, in the East Indies. The climate is very hot; and would be intolerable, were it not for the rains which fall when the sun is directly over their heads. The soil is extremely fertile, and there are ripe fruits at all times of the year. There are great numbers of monkies, who are devoured by monstrous serpents; some of which are so large, that they will swallow one of these animals entire. The Macassars are large, robust, courageous, and greatly addicted to war. They profess the Mahometan religion.

MACASSAR, a large, strong, and handsome town, of the island of Celebes, and capital of the kingdom of the same name, where the king resides. The houses are all built of wood, and supported by thick posts; and they have ladders to go up into them, which they draw up as soon as they have entered. The roofs are covered with very large leaves, which prevent the rain from entering. It is seated near the mouth of a large river, which runs through the kingdom from north to south. E. Long. 117. 55. S. Lat. 5. 0.

MACASSAR *Poison*, in *Natural History*, called *ippo* in the Macassar and Malayan tongue, is the gum of a certain tree, shining, brittle, black, and every way like stone pitch, growing in the island of Celebes, in the South seas; with which all the natives arm themselves in travel, having a long hollow trunk of a hard red wood like brasil, accurately bored, and at one end is fixed a large lance-blade of iron. Then they make a small arrow, very straight, and somewhat bigger than a large wheaten straw: at one end they fix it into a round piece of white, light, soft wood, like cork, about the length of the little finger, just fit for the bore of the trunk, to pass clear by the force of one's breath, and to fill it so exactly, that the air may not pass by, but against it, in order to carry it with the greater force. At the other end they fix in it either a small fish-tooth for that purpose, or make a blade of wood of the bigness of the point of a lancet, about three-quarters of an inch long, and making a little notch in the end of the arrow, they stick it firm therein, which they anoint with poison. The poisonous gum, when gathered, is put into hollow bamboos or canes, stopped up very close, and thus brought to Macassar. When they fit it for use, they take a piece of smooth turtle-shell, and a stick cut flat and smooth at the end: then they take green galangal root, grate it, and with the addition of a little fair water, press the juice into a clean china dish: then with a knife scraping a little of the poison upon the shell, dip the end of the stick in the forementioned liquor, and with this dissolve the poison to the consistence of a syrup: when this is done, they anoint the fish-tooth or wooden blade with the same stick, and lay it in the sun, so that it may be baked hard. The pointed arrows thus prepared, are put in hollow bamboos, close shut, and in this state they retain their virtue for a month.

MACCABÆUS, JUDAS. See JUDAS.

MACCABEES, two apocryphal books of scripture, containing the history of Judas and his brothers, and their wars against the Syrian kings in defence of their religion and liberties, so called from Judas Mattathias, surnamed *Maccabæus*, as some say from the word מכבי, formed of the initials of מי כמכה באלם יהוה, q. d. *Who is like unto thee, O Lord, among the gods*; which was the motto of his standard; whence those who fought under his standard were called *Maccabees*, and the name was generally applied to all who suffered in the cause

of

Maccabees, Macbeth.

of the true religion, under the Egyptian or Syrian kings. The firſt book of the Maccabees is an excellent hiſtory, and comes neareſt to the ſtyle and manner of the ſacred hiſtorians of any extant. It was written originally in the Chaldee language, of the Jeruſalem dialect, and was extant in this language in the time of Jerome. From the Chaldee it was tranſlated into Greek, from the Greek into Latin. It is ſuppoſed to have been written by John Hyrcanus the ſon of Simon, who was prince and high prieſt of the Jews near 30 years, and began his government at the time where this hiſtory ends. It contains the hiſtory of 40 years, from the reign of Antiochus Epiphanes to the death of Simon the high prieſt: that is, from the year of the world 3829 to the year 3869; 131 years before Chriſt. The ſecond book of the Maccabees begins with two epiſtles ſent from the Jews of Jeruſalem to the Jews of Egypt and Alexandria; to exhort them to obſerve the feaſt of the dedication of the new altar erected by Judas on his purifying the temple. The firſt was written in the 169th year of the era of the Seleucidæ, i. e. before Chriſt 144; and the ſecond in the 188th year of the ſame era, or 125 before Chriſt; and both appear to be ſpurious. After theſe epiſtles follows the preface of the author to his hiſtory, which is an abridgement of a larger work, compoſed by one Jaſon, a Jew of Cyrene, who wrote in Greek the hiſtory of Judas Maccabeus and his brethren, and the wars againſt Antiochus Epiphanes, and Eupator his ſon. The ſecond book does not by any means equal the accuracy and excellency of the firſt. It contains a hiſtory of about 15 years, from the execution of Heliodorus's commiſſion, who was ſent by Seleucus to fetch away the treaſures of the temple, to the victory obtained by Judas Maccabeus over Nicanor; that is, from the year of the world 3828, to the year 3843, 147 years before Chriſt.

There are in the Polyglot Bibles, both of Paris and London, Syriac verſions of both theſe books; but they, as well as the Engliſh verſions which we have among the apocryphal writers in our Bibles, are derived from the Greek. There is alſo a third book of the Maccabees, containing the hiſtory of the perſecution of Ptolemy Philopator againſt the Jews in Egypt, and their ſufferings under it; which ſeems to have been written by ſome Alexandrian Jew in the Greek language, not long after the time of Siracides. It is in moſt of the ancient manuſcript copies of the Greek Septuagaint; particularly in the Alexandrian and Vatican, but was never inſerted into the vulgar Latin verſion of the Bible, nor conſequently into any of our Engliſh copies. Moreover, Joſephus's hiſtory of the martyrs that ſuffered under Antiochus Epiphanes, is found in ſome manuſcript Greek Bibles, under the name of the fourth book of the *Maccabees*.

MACBETH, a Scots nobleman in the 11th century, nearly allied to Duncan king of Scotland.—Not contented with curbing the king's authority, he carried his peſtilent ambition ſo far as to put him to death; and, chaſing Malcolm Canmore his ſon and heir into England, uſurped the crown. Siward earl of Northumberland, whoſe daughter Duncan had married, undertook, by the order of Edward the Confeſſor, the protection of the fugitive prince.—He marched with an army into Scotland; defeated and killed Macbeth; and reſtored Malcolm to the throne of his anceſtors. Shakeſpeare has made this tranſaction the ſubject of one of his beſt tragedies.

Macbride.

MACBRIDE, Dr David, an eminent phyſician and philoſopher, was deſcended from an ancient family in the county of Galloway in Scotland. His grandfather, a clergyman, had ſettled in Ireland about the end of the laſt century, as miniſter to a Preſbyterian congregation at Belfaſt; and his father, who followed the ſame line, was ſettled at Ballymony in the county of Antrim, where he married, and where our author was born in April 1726. After a proper ſchool-education, and having paſſed ſome time under the tuition of an eminent ſurgeon in his native place, he was ſent to the univerſity of Glaſgow. Having there completed the uſual courſe of academical ſtudies, he came to Edinburgh for the further proſecution of medical ſcience. After a ſhort ſtay here, a war then prevailing between France and Britain, he was induced to go on board the navy in the ſtation of a ſurgeon's mate. In the ſervice of his country he continued for ſeveral years; and after diſcharging for ſome time the duties of an aſſiſtant, he was raiſed to the rank of ſurgeon. In this ſituation, he firſt turned his thoughts towards the diſcovery of a remedy for the ſea-ſcurvy. It was not, however, at this period, that either chance or reaſoning ſuggeſted to him the employment of an article which has ſince been attended with the moſt beneficial conſequences. Here he had an opportunity only of obſerving the ſymptoms, of ſtudying the nature, and of lamenting the conſequences, of the diſeaſe.

The termination of the war by the peace of Aix-la-Chapelle put a period to Dr Macbride's employment as a naval ſurgeon. He had now probably obtained much medical knowledge in the ſchool of experience; but he was ſenſible that he had ſtill much to acquire in that of ſcience. An ardent keenneſs to mingle in active life had led him from the ſchools of medicine at an earlier period than could have been wiſhed; and an earneſt deſire to found his future practice in the beſt eſtabliſhed principles led him back to them, when a judgement, matured by years, and informed from the obſervation of facts, rendered him capable of hearing teachers with greater advantage. He returned therefore to Edinburgh, and again entered on the career of academical purſuits, under the tuition of Dr Monro, and thoſe other teachers, whoſe abilities raiſed the fame of the medical ſchool at this place. But not ſatiſfied with the inſtructions to be had from any one ſet of profeſſors, the celebrity of the medical teachers in London led him alſo to viſit that capital. There he particularly became the pupil of thoſe diſtinguiſhed lecturers, Dr Hunter and Dr Smellie. And while from the former he laboured to acquire an accurate chirurgical knowledge, from the latter he endeavoured to obtain the true principles of midwifery conſidered as a ſcience. At the ſame time he was no leſs induſtrious in improving himſelf in the ſucceſsful practice of both arts by attention at hoſpitals.

Thus prepared for the exerciſe of his profeſſion, about the end of the year 1749 he fixed his reſidence in Dublin in the character of ſurgeon and accoucheur. If amiable manners, and extenſive knowledge of his profeſſion, could alone have been ſufficient introductions to practice, he might in a ſhort time have looked

Macbride. ed for a competent ſhare of buſineſs in that capital; but while he had to combat that objection which very generally ariſes from youth, his progreſs was alſo not a little retarded by an uncommon degree of modeſty. Hence for ſeveral years he remained almoſt in a ſtate of obſcurity, and was employed by but few people either of rank or fortune. But, if it is to be regretted that for many years his time was not ſo fully employed in the lucrative part of his profeſſion as was due to his merit, it ought ſtill to be remembered, that this eſſentially promoted the cauſe of ſcience: for by this means his genius and induſtry were directed to medical reſearches; and were productive of diſcoveries which will with honour tranſmit his name to lateſt poſterity. Theſe, though ſome of them might have been ſucceſsfully turned to his own emolument, were freely communicated to the world in different publications; and he did not ſhow greater ingenuity in making diſcoveries, than liberality of ſentiment in publiſhing them for the advantage of others.—His firſt publication, entitled, "Experimental Eſſays on Medical and Philoſophical Subjects," made its appearance in the year 1764.—Theſe eſſays are five in number: 1. On the fermentation of alimentary mixture and the digeſtion of the food. 2. On the nature and properties of fixed air. 3. On the different kinds of antiſeptics. 4. Of the diſſolvent power of quicklime. 5. Of the ſea-ſcurvy. The merit of all theſe is ſufficiently known and acknowledged: but the laſt of them is unqueſtionably the moſt important; the method therein propoſed of both the prevention and cure of that dreadful diſeaſe, the ſcurvy, having been confirmed by repeated and undeniable obſervation.

Having thus equally diſtinguiſhed himſelf as an ingenious philoſopher and able practitioner, the world were not now ſlow in beſtowing upon him the tribute of applauſe to which he was entitled. His name was enrolled with honour in the liſts of many learned ſocieties; and the univerſity where his ſtudies had firſt been commenced, were proud to confer upon him the degree of doctor of medicine.

The reputation, however, of being a diſtinguiſhed author, was to him but a ſecondary object; and his talents were not confined to the advancement of medicine alone. Having ſucceſsfully diſcovered a conſiderable improvement in the art of tanning, with that ſpirited generoſity which is ever the concomitant of real worth, he ſpeedily and freely communicated it to the public, by publiſhing, firſt, "An Account of a New Method of Tanning;" and afterwards, "Inſtructions for carrying on the New Method of Tanning." As a mark of approbation for this liberal conduct, as well as a teſtimony of reſpect for his ingenuity, prize-medals were conferred upon him by the Societies of Arts both in London and Dublin. But his laſt and moſt extenſive publication was more immediately in the line of his own profeſſion: It is entitled, "A Methodical Introduction to the Theory and Practice of Medicine." In that valuable work he has given a conciſe and connected view of the principles and practice of the healing art, as beſt eſtabliſhed by ſound reaſon, and confirmed by accurate obſervation. Moſt, if not all, of theſe publications, not only went through various editions, but were tranſlated into different languages.

After the merit of Dr Macbride came to be properly known, the public ſeemed to ſhow a deſire of making compenſation for having ſo long overlooked it. His employment increaſed ſo rapidly, that he had more buſineſs than he could tranſact either with eaſe or ſafety. This having kept him in perpetual agitation both of body and mind, at laſt induced an almoſt total incapacity of ſleeping. From this circumſtance his health could not fail to be impaired. In this ſituation, after accidental expoſure to cold, he was attacked with a fever, which put an end to his life on the 13th of December 1778, in the 53d year of his age. Macbride || Mace.

Thoſe who were his moſt intimate acquaintance were inclined to believe that his death was not a little haſtened by domeſtic calamities. During his reſidence in Dublin he was twice married, and was as often ſubjected to that inexpreſſible diſtreſs which muſt reſult from a final ſeparation in this world from the moſt intimate and loving friends. By both of his wives he had ſeveral children; but none of them ſurvived their father. And on theſe calamitous events, although he was able to conceal his feelings from the world, yet they gave a ſevere ſhock to his conſtitution. After his death, ſeveral of the playful trinkets of his infants, with the ſignature of *dulces exuviæ*, were found in his repoſitories among papers on medical and other important ſubjects: an incontrovertible proof, that in him at leaſt, the great mind of the philoſopher was conjoined with the feeling heart of the affectionate father. But if his abilities were remarkable as a philoſopher and phyſician, if his conduct was exemplary as a huſband and parent, his manners were no leſs amiable as a companion and friend. His polite and benevolent conduct, joined to his taſte for the fine arts, conciliated the affections and eſteem of all who knew him. His death was univerſally and ſincerely lamented in the city of Dublin.

MACCLESFIELD, a town of Cheſhire in England, 171 miles from London, is ſeated on the edge of a foreſt of the ſame name, upon a high bank near the river Bollin; and is a large handſome town, with a fine church and a very high ſteeple. It was erected into a borough by King Edward III. is governed by a mayor, and enjoys great privileges and juriſdictions by virtue of the court and the liberties of the foreſt. In its church are two braſs plates, on one of which there is a promiſe of 26,000 years and 26 days pardon for ſaying five Pater-Noſters and five Aves. Its chief manufacture is mohair buttons. In Macclesfield foreſt are many pits dug for the ſake of the turf; in which it is common to find fir-trees buried, which are dug up for various uſes, but chiefly for ſplinters that ſerve the poor for candles. W. Long. 2. 10. N. Lat. 53. 15.

MACE, an ancient weapon, formerly much uſed by the cavalry of all nations. It was commonly made of iron; its figure much reſembles a chocolate mill; many ſpecimens may be ſeen in the Tower. It was with one of theſe that Walworth mayor of London knocked the rebel Wat Tyler from off his horſe in Smithfield for approaching the young King Richard II. in an inſolent manner; and as he fell, he diſpatched him with his dagger. The mace in modern times changed its form; and being no longer a war inſtrument, is made of copper or ſilver gilt, ornamented with a

Mace, Macedon. a crown, globe, and croſs, and is now the chief inſignia of authority throughout Great Britain. Similar to the ancient maces, were thoſe ſtaves at the end of which iron or leaden balls armed with ſpikes were ſuſpended by chains: they were till lately carried by the pioneers of the trained bands or city militia.

Mace, in the *Materia Medica*, the ſecond coat or covering of the kernel of the nutmeg, is a thin, membranaceous ſubſtance, of a yellowiſh colour; being met with in flakes of an inch or more in length, which are divided into a multitude of ramifications. It is of an extremely fragrant, aromatic, and agreeable flavour; and of a pleaſant, but acrid oleaginous taſte. See Materia Medica *Index*.

MACEDON, or Macedonia, a moſt celebrated kingdom of antiquity, was bounded on the eaſt by the Ægean ſea; on the ſouth by Theſſaly and Epirus; on the weſt by the Ionian ſea or Adriatic; on the north, at firſt by the river Strymon and the Scardian mountains, but afterwards by the river Neſſus or Neſtus.

1 Situation, &c. of the country.

In a direct line the whole country extended only 150 miles in length; but the windings of the coaſt lengthened it out to three times that extent; in which almoſt every convenient ſituation was occupied by a Grecian ſea-port. The country was naturally divided by the Thermaic and Strymonic gulfs, into the provinces of Pieria, Chalcis, and Pangæus. The middle region, which took its name from a city of Eubœa from whence it was originally peopled, was very fertile and pleaſant; the inland country, being diverſified by lakes, rivers, and arms of the ſea, was extremely convenient for inland navigation, while the towns of Amphipolis, Potidæa, Acanthus, and many others, afforded marts for the commerce of the republics of Greece, as well as of Thrace and Macedon. On one ſide of this diſtrict were the mountains of Pangæus, and on the other the plains of Pieria. The Pangæan mountains, which extended 90 miles towards the eaſt and the river Neſſus, though proper neither for corn nor paſture, produced plenty of timber for ſhip-building; while the ſouthern branches of the mountains contained rich veins of gold and ſilver; but theſe, though wrought ſucceſſively by the Thaſians and the Athenians, were only brought to perfection by Philip of Macedon, who extracted from them gold and ſilver to the value of 200,000l. ſterling annually. Pieria extended 50 miles along the Thermaic gulf, to the confines of Theſſaly and Mount Pindus. The inland part of the country was beautifully diverſified with ſhady hills and fountains; and ſo admirably calculated for ſolitary walks and retirement, that the ancients looked upon it to be the favourite haunt of the Muſes, and accordingly beſtowed upon them the title of *Pierides*.

2 Different names.

In the moſt early times this country was called *Æmathia*, from *Æmathius* one of its princes. The name of *Macedon* is ſaid to have been derived from *Macedo* a deſcendant of Deucalion; though others ſuppoſe it to have been only a corruption of *Mygdonia* a diſtrict of the country. In thoſe remote ages of antiquity, Macedon, like moſt other countries of Europe, was divided into a great number of petty principalities, of which ſcarce even the names are known at this time.

3 Kingdom founded by Caranus.

All authors agree, however, that *Caranus* was the firſt who eſtabliſhed any permanent ſovereignty in Macedon. He was an Argive, a deſcendant of Hercules, and about 800 years B. C. conducted a ſmall colony of his countrymen into the inland diſtrict of Macedon, at that time diſtinguiſhed by the name of *Æmathia* as already mentioned. This territory was about 300 miles in circumference. On the ſouth it was ſeparated from the ſea by a number of Greek republics, of which the moſt conſiderable were thoſe of Olynthus and Amphipolis; and on the north, eaſt, and weſt, was ſurrounded by the barbarous kingdoms of Thrace, Pœonia, and Illyricum. According to the traditions of thoſe times, Caranus, having conſulted the oracle on the ſucceſs of his intended expedition, was commanded to be directed by the goats in the eſtabliſhment of his empire. For ſome time he proceeded at random, without knowing what to make of the oracle's anſwer; but happening to enter the ſmall kingdom of *Æmathia*, at that time governed by King Midas, he obſerved a herd of goats running towards *Edeſſa* the capital. Recollecting then the anſwer of the oracle, he attacked and took the city by ſurpriſe, ſoon after making himſelf maſter of the whole kingdom. In memory of this remarkable event he called the city *Ægea*, and the people *Ægiates*, from the goats who conducted him, and made uſe of the figure of a goat in his ſtandard. From this fable alſo we ſee why the figure of a goat is ſo frequently ſeen on the coins of Philip and his ſucceſſors.

4 Policy of this prince.

The little colony of Argives led into Æmathia by Caranus would ſoon have been overwhelmed by the barbarous nations who ſurrounded it, had not this prince and his ſubjects taken care to ingratiate themſelves with their neighbours, rather than to attempt to ſubdue them by force of arms. They inſtructed them in the Grecian religion and government, and in the knowledge of many uſeful arts; adopting themſelves, in ſome degree, the language and manners of the barbarians; imparting to them in return ſome part of the Grecian civilization and polite behaviour. Thus they gradually aſſociated with the fierce and warlike tribes in their neighbourhood; and this prudent conduct, being followed by ſucceeding generations, may be looked upon as one of the cauſes of the Macedonian greatneſs.

Caranus, dying after a reign of three years, left the kingdom to his ſon Cœnus; who having conſiderably enlarged his dominions, was ſucceeded by Thurymas, and he by Perdiccas I.

5 Perdiccas I. a celebrated monarch.

This laſt prince is by Thucydides and Herodotus accounted the founder of the Macedonian monarchy; though his hiſtory is ſo obſcured by fable, that nothing certain can now be known concerning it. In proceſs of time, however, the good underſtanding which had ſubſiſted between the Macedonians and their barbarous neighbours began to ſuffer an interruption; and in 691 B. C. the kingdom was for the firſt time invaded by the Illyrians.

6 Invaſion by the Illyrians.

At firſt they did conſiderable damage by their ravages; but the Macedonian monarch, Argæus, having decoyed them into an ambuſh, cut off great numbers, and obliged the remainder to leave the kingdom. In the reigns of his ſucceſſors, however, they returned, and occaſionally proved very troubleſome enemies till the reigns of Philip and Alexander.

7 Interference of the Perſians and Macedonians.

In the mean time the kingdom of Macedon began to be affected by thoſe great events which took place in other parts of the world. Cyrus having overthrown the

the Babylonian empire, and conquered all the weſtern part of Aſia, eſtabliſhed a mighty monarchy, which threatened all the eaſtern parts of Europe with ſubjugation. The Greeks, however, having now emerged from their barbariſm, and acquired great knowledge in the art of war, were able to reſiſt effectually this very formidable power; but the kingdom of Macedon, obſcure and unconnected, was obliged to yield, and though not formally made a province of the Perſian empire, was nevertheleſs accounted in ſome ſort as under the vaſſalage and protection of the Perſians. Alcetas, who aſcended the Macedonian throne about the time that the Perſian monarchy was founded, had the dexterity to preſerve his dominions from the encroachments of the Greeks on the one hand, and of the Perſians on the other; but in the reign of his ſucceſſor Amyntas, a formal demand was made of ſubmiſſion to the great king Darius, by ſending him a preſent of earth and water. Seven ambaſſadors were ſent on this errand by Megabizus, one of the officers of Darius. They were ſumptuouſly entertained by Amyntas; but having attempted to take ſome indecent liberties with the Macedonian women, Alexander the king's ſon cauſed them all to be murdered. This raſh action had almoſt proved the ruin of the kingdom; but Alexander found means to pacify Bubaris the general ſent againſt him by Megabizus, by ſhowing him his ſiſter Gygæa, a very beautiful woman, with whom the Perſian fell in love at firſt ſight, and afterwards married her.

8
Advantages accruing to Macedon from this interference.

From this time the Macedonians were accounted the faithful allies of the Perſians; and, through the intereſt of his ſon-in-law, Amyntas obtained the country in the neighbourhood of Mount Hæmus and Olympus, at the ſame time that the city of Alabanda in Phrygia was given to Amyntas the nephew of Alexander. The Macedonians diſtinguiſhed themſelves in the time of the Perſian invaſion of Greece, by furniſhing their allies with 200,000 recruits; though ſome cities, particularly Potidæa, Olynthus, and Pallene, adhered to the Grecian intereſt. The two laſt were taken and raſed, and the inhabitants maſſacred by the Perſians; but Potidæa eſcaped by reaſon of the ſea breaking into the Perſian camp, where it did great damage. Alexander, however, afterwards thought proper to court the favour of the Greeks by giving them intelligence of the time when Mardonius deſigned to attack them. The remaining tranſactions of this reign are entirely unknown, farther than that he enlarged his dominions to the river Neſſus on the eaſt and the Axius on the weſt.

9
Reign of Perdiccas II

Alexander I. was ſucceeded by his ſon Perdiccas II. who, according to Dr Gillies, "inherited his father's abilities, though not his integrity." But from his duplicity above mentioned both to Greeks and Perſians, it does not appear that he had much to boaſt of as to the latter quality. In the Peloponneſian war he eſpouſed the cauſe of the Spartans againſt the Athenians, from whom he was in danger by reaſon of their numerous ſettlements on the Macedonian coaſt, and their great power by ſea. For ſome time, however, he amuſed the Athenians with a ſhow of friendſhip; but at laſt, under pretence of enabling Olynthus and ſome other cities to recover their liberties, he aſſiſted in deſtroying the influence of the Athenians in thoſe places, in hopes of eſtabliſhing that of the Macedonians in its ſtead. But this deſign failed of ſucceſs; the Olynthian confederacy was broken, and the members of it became ſubject to Sparta, until at laſt, by the misfortunes of that republic, they became ſufficiently powerful not only to reſiſt the encroachments of the Macedonians, but to make conſiderable conqueſts in their country.

10
Of Archelaus I.

Perdiccas II. was ſucceeded about 416 B. C. by Archelaus I. He enlarged his dominions by the conqueſt of Pydna, and other places in Pieria, though his ambition ſeems rather to have been to improve his dominions than greatly to extend them. He facilitated the communication between the principal towns of Macedon, by cutting ſtraight roads through moſt part of the country: he built walls and fortreſſes in ſuch places as afforded a favourable ſituation; encouraged agriculture and the arts, particularly thoſe ſubſervient to war; formed magazines of arms; raiſed and diſciplined a conſiderable body of cavalry; and in a word, ſays Dr Gillies, added more to the ſolid grandeur of Macedon than had been done by all his predeceſſors put together. Nor was he regardleſs of the arts of peace. His palace was adorned by the works of Grecian painters. Euripides was long entertained at his court; Socrates was earneſtly ſolicited to live there, after the example of this philoſophic poet, formed by his precepts and cheriſhed by his friendſhip: men of merit and genius in the various walks of literature and ſcience were invited to reſide in Macedon, and treated with diſtinguiſhed regard by a monarch duly attentive to promote his own glory and the happineſs of his ſubjects."

11
The kingdom becomes a prey to civil diſſenſions.

This great monarch died after a reign of ſix years, a ſpace by far too ſhort to accompliſh the magnificent projects he had formed. After his death the kingdom fell under the power of uſurpers or weak and wicked monarchs. A number of competitors conſtantly appeared for the throne; and theſe by turns called in to their aſſiſtance the Thracians, Illyrians, Theſſalians, the Olynthian confederacy, Athens, Sparta, and Thebes. Bardyllis, an active and daring chief, who, from being head of a gang of robbers, had become ſovereign of the Illyrians, entered Macedon at the head of a numerous army, depoſed Amyntas II. the father of Philip, and ſet up in his place one Argæus, who conſented to become tributary to the Illyrians. Another candidate for the throne, named *Pauſanias*, was ſupported by the Thracians; but, by the aſſiſtance of the Theſſalians and Olynthians, Amyntas was enabled to reſume the government. After his reſtoration, however, the Olynthians refuſed to deliver up ſeveral places of importance belonging to Macedon which Amyntas had either intruſted to their care, or which they had taken from his antagoniſt. Amyntas complained to Sparta; and that republic, which had already formed ſchemes of very extenſive ambition, ſo readily complied with the requeſt, that it was generally ſuppoſed to have proceeded from Spartan emiſſaries ſent into Macedonia. They pretended indeed to heſitate a little, and to take time to deliberate on the army which ought to be raiſed for the purpoſe; but Cleigenes, the principal ambaſſador, repreſented the urgency of the caſe in ſuch a manner, that the troops which happened at that time to be ready were ordered to take the field without delay. Two thouſand Spartans, under the command

12
War with the Olynthians.

command of Eudamidas, were ordered into Macedon, while a powerful reinforcement under the command of Phœbidas, brother to the general, was ordered to follow him as ſoon as poſſible. By accident, Phœbidas and his auxiliaries were detained till the ſeaſon for action was paſſed; but Eudamidas with his ſmall army performed very eſſential ſervice. The appearance of a Spartan army at once encouraged the ſubjects and allies of the Olynthians to revolt; and the city of Potidæa, a place of great importance in the iſthmus of Pallene, ſurrendered ſoon after his arrival in the country. Being too much elated with his ſucceſs, however, Eudamidas approached ſo near the city of Olynthus, that he was unexpectedly attacked, defeated, and killed, in a ſally of the citizens. He was ſucceeded by Teleutias the brother of Ageſilaus, who had under his command a body of 10,000 men, and was farther aſſiſted by Amyntas king of Macedon, and Derdas his brother, the governor or ſovereign of the moſt weſterly province of Macedon, which abounded in cavalry. By theſe formidable enemies the Olynthians were defeated in a number of battles, obliged to ſhut themſelves up in their city, and prevented from cultivating their territory; on which Teleutias advanced with his whole forces to inveſt the city itſelf. His exceſſive eagerneſs to deſtroy his enemies proved his ruin. A body of Olynthian horſe had the boldneſs to paſs the river Amnias in ſight of the allied army, though ſo much ſuperior in number. Teleutias ordered his targeteers to attack them, the Olynthians, having retreated acroſs the river, were cloſely purſued by the Lacedemonians, great part of whom alſo paſſed the river; but the Olynthians ſuddenly turned upon them, killed upwards of 100, with Tlemonidas their leader. Teleutias, exaſperated at this diſaſter, ordered the remainder of the targeteers and cavalry to purſue; while he himſelf advanced at the head of the heavy-armed foot with ſuch celerity that they began to fall into diſorder. The Olynthians allowed them to proceed, and the Lacedemonians very imprudently advanced juſt under the towers and battlements of the city. The townſmen then mounted the walls, and diſcharged upon them a ſhower of darts, arrows, and other miſſile weapons, while the flower of the Olynthian troops, who had been purpoſely poſted behind the gates, ſallied forth and attacked them with great violence. Teleutias, attempting to rally his men, was ſlain in the firſt onſet; the Spartans who attended him were defeated, and the whole army at laſt diſperſed with great ſlaughter, and obliged to ſhelter themſelves in the towns of Acanthus, Apollonia, Spartolus, and Potidæa.

The Spartans, undiſmayed by this terrible diſaſter, next ſent their king Ageſipolis with a powerful reinforcement into Macedon. His preſence greatly raiſed the ſpirits of the Lacedemonian allies, and his rapid ſucceſs ſeemed to promiſe a ſpeedy termination to the war, when he himſelf died of a calenture. He was ſucceeded in the throne by his brother Cleombrotus, and in the command of the army by Polybiades an experienced general, who likewiſe brought along with him a powerful reinforcement. Olynthus was now completely blocked up by land, while a ſquadron of Lacedemonian galleys blocked up the neighbouring harbour of Myceberna. The Olynthians, however, held out for nine or ten months, but at laſt were obliged to ſubmit on very humiliating conditions. They formally renounced all claim to the dominion of Chalcis; they ceded the Macedonian cities to their ancient governor;

13 The Olynthians obliged to ſubmit.

and in conſequence of this Amyntas left the city of Ægæa or Edeſſa, where till now he had held his royal reſidence, and fixed it at Pella, a city of great ſtrength and beauty, ſituated on an eminence, which, together with a plain of conſiderable extent, was defended by impaſſable moraſſes, and by the rivers Axius and Lydias. It was diſtant about 15 miles from the Ægean ſea, with which it communicated by means of the abovementioned rivers. It was originally founded by the Greeks, who had lately conquered and peopled it; but in conſequence of the misfortunes of Olynthus, it now became the capital of Macedon, and continued ever after to be ſo.

14 Pella made the capital of Macedon.

Amyntas, thus fully eſtabliſhed in his dominions, continued to enjoy tranquillity during the remaining part of his life. The reign of his ſon Alexander was ſhort, and diſturbed by invaſions of the Illyrians; from whom he was obliged to purchaſe a peace. He left behind him two brothers, Perdiccas and Philip, both very young; ſo that Pauſanias again found means to uſurp the throne, being ſupported not only by the Thracians, but a conſiderable number of Greek mercenaries, as well as a powerful party in Macedon itſelf.

15 Pauſanias uſurps the throne.

In this critical juncture, however, Iphicrates the Athenian happening to be on an expedition to Amphipolis, was addreſſed by Eurydice the widow of Amyntas, ſo warmly in behalf of her two ſons, whom ſhe preſented to him, that he intereſted himſelf in their behalf, and got Perdiccas the eldeſt eſtabliſhed on the throne. He was induced alſo to this piece of generoſity by the kindneſs which Eurydice and her huſband had formerly ſhown to himſelf; and he likewiſe ſaw the advantages which muſt enſue to his country from a connexion with Macedon. During the minority of the young prince, however, his brother Ptolemy, who was his guardian, openly aſpired to the throne;

16 Ptolemy aſpires to the throne.

but he was depoſed by the Theban general Pelopidas, who reinſtated Perdiccas in his dominions; and in order to ſecure, in the moſt effectual manner, the dependence of Macedon upon Thebes, carried along with him thirty Macedonian youths as hoſtages; and among them Philip, the younger brother of the king. Perdiccas now, elated by the protection of ſuch powerful allies, forgot Iphicrates and the Athenians, and even diſputed with them the right to the city of Amphipolis, which had been decreed to them by the general council of Greece, but which his oppoſition rendered impoſſible for them to recover. In conſequence of the truſt he put in theſe new allies, alſo, it is probable that he refuſed to Bardyllis the Illyrian the tribute which the Macedonians had been obliged to pay him; which occaſioned a war with that nation. In this conteſt the Macedonians were defeated with the loſs of 4000 men, Perdiccas himſelf being taken priſoner, and dying ſoon after of his wounds.

17 The Macedonians defeated, and their king killed by the Illyrians.

The kingdom was now left in the moſt deplorable ſtate. Amyntas, the proper heir to the throne, was an infant; the Thebans, in whom Perdiccas had placed ſo much confidence, were deprived of the ſovereignty of Greece; the Athenians, juſtly provoked at the ungrateful behaviour of the late monarch, ſhowed a hoſ-

 tile

Macedon. tile difpofition; the Illyrians ravaged the weft, and the Pæonians the north quarter of the kingdom; the Thracians ftill fupported the caufe of Paufanias, and propofed to fend him into Macedon at the head of a numerous army; while Argæus, the former rival of Amyntas, renewed his pretenfions to the throne, and by flattering the Athenians with the hopes of recovering Amphipolis, eafily induced them to fupport his claims; and in confequence of this they fitted out a fleet, having on board 3000 heavy-armed foldiers, which they fent to the coaft of Macedon.

18 Philip arrives in Macedon. Philip, the late king's brother, no fooner heard of his defeat and death, than he fet out privately from Thebes; and on his arrival in Macedon found matters in the fituation we have juft now defcribed. Fired with an infatiable ambition, it is very probable that from the very firft moment he had refolved to feize the kingdom for himfelf; yet it was neceffary at firft to pretend that he affumed the throne only to preferve it for his nephew. Philip, as has already been mentioned, was carried off as a hoftage by Pelopidas, but for a long time paft had remained in fuch obfcurity, that hiftorians difagree as to his place of refidence; fome placing him in Thebes, and others in Macedon. It is certain, however, that from the age of 15 he had been very much in the family of Epaminondas, from whofe leffons he could not but derive the greateft emolument. It is probable alfo that he attended this celebrated general in many of his expeditions; and it is certain, that, with an attendance fuitable to his rank, he vifited moft of the principal republics, and fhowed an attention to their inftitutions, both civil and military, far fuperior to his years. Having eafy accefs to whomfoever he pleafed, he cultivated the friendfhip of the firft people in Greece. Even in Athens, where no good will fubfifted with Macedon, the philofophers Plato, Ifocrates, and Ariftotle, cultivated his acquaintance: and the connexion he formed with the principal leaders of that republic in the early period of his life, no doubt contributed greatly to the accomplifhment of the defigns in which he afterwards proved fo fuccefsful.

19 Retrieves the affairs of the kingdom. His appearance in Macedon inftantly changed the face of affairs: the Macedonian army, though defeated, was not entirely deftroyed; and the remainder of them fecured themfelves in the fortreffes which had been built by Archelaus. There were alfo confiderable garrifons in the fortreffes, and walled towns fcattered over the kingdom; and the Illyrians, who had made war only for the fake of plunder, foon returned home to enjoy the fruits of their victory. His other enemies, the Thracians and Pæonians, were much lefs formidable than the Illyrians, being ftill in a very rude and uncivilized ftate, incapable of uniting under one head in fuch a manner as to bring any formidable army into the field. While the Illyrians therefore gave up the campaign through mere caprice and unfteadinefs, Philip himfelf applied to the Pæonians, and by fair promifes and flattery prevailed upon them to defift. The king of Thrace, by means of a fum of money, was eafily prevailed upon to abandon the caufe of Paufanias; fo that Philip, freed from thefe barbarians, was now left at liberty to oppofe the Athenians, who fupported Argæus, and threatened a very formidable invafion.

The appearance of the Athenian fleet before Methone, with that of Argæus at the head of a numerous army in Pieria, filled the whole country with confternation; and Philip, who was by no means deficient in talents neceffary to recommend himfelf to the good graces of the people, took the opportunity of getting Amyntas fet afide, and himfelf declared king; for which indeed the danger of the times afforded a very plaufible pretext. Argæus, in the mean time, advanced with his Athenian allies towards Edeffa or Ægæ, the ancient capital of the Macedonian empire, where he hoped to have been amicably received; but finding the gates fhut againft him, he returned back to Methone. Philip haraffed him in his retreat, cutting off great numbers of his men, and afterwards defeated him in a general engagement; in which Argæus himfelf, with the flower of his army, was cut in pieces, and all the reft taken prifoners. Macedon. 20 Takes upon him the fovereignty. 21 Defeats and kills Argæus an ufurper.

This firft inftance of fuccefs contributed greatly to raife the fpirits of Philip's party; and he himfelf took care to improve it in the beft manner poffible. Having taken a great number of prifoners, both Macedonians and Athenians, he determined, by his treatment of them, to ingratiate himfelf with both parties. The former were called into his prefence, and, after a gentle reprimand, admitted to fwear allegiance to him; after which they were diftributed through the army: the Athenians were entertained at his table, difmiffed without ranfom, and their baggage reftored. The prifoners were juft allowed time to return to their native city and to fpread abroad the news of Philip's generofity, when they were followed by ambaffadors from Macedon with propofals for peace. As he knew that the lofs of Amphipolis had greatly irritated them, he now thought proper to renounce his jurifdiction over that city; and it was accordingly declared free and independent, and fubject only to the government of its own free and equitable laws. This artful conduct, together with his kind treatment of the prifoners, fo wrought upon the minds of the Athenians, that they confented to the renewal of a treaty which had formerly fubfifted between them and his father Amyntas. Thus he found means to remove all jealoufy of his ambition or the fchemes he might afterwards undertake to their prejudice; and not only this, but to induce them to engage in a ruinous war with their allies, which occupied their attention until Philip had an opportunity of getting his matters fo well eftablifhed that it was impoffible to overthrow them. 22 Philip's politic treatment of the prifoners. 23 Renounces his right to Amphipolis.

The new king being thus left at liberty to regulate his domeftic concerns, began to circumfcribe the power of his chiefs and nobles; who, efpecially in the more remote provinces, paid very little regard to the authority of the kings of Macedon; fometimes, even in times of public calamity, throwing off their allegiance altogether, and affuming an independent government over confiderable tracts of country. To counteract the ambition of thefe chiefs, Philip chofe a body of the braveft Macedonian youths, whom he entertained at his own table, and honoured with many teftimonies of his friendfhip, giving them the title of his *companions*, and allowing them conftantly to attend him in war and hunting. Their intimacy with the fovereign, which was confidered as an indication of their merit, obliged them to fuperior diligence in all the fevere duties of military difcipline; and the young nobility, eager to participate fuch high honours, vied with each other 24 Reduces the power of the nobility. 25 Choofes a number of illuftrious young men for his companions.

Macedon.

other in their endeavours to gain admiſſion into this diſtinguiſhed order; ſo that while on the one hand they ſerved as hoſtages, on the other they formed an uſeful ſeminary for future generals, by whom both Philip and Alexander were afterwards greatly aſſiſted in their conqueſts.

26 Whether he inſtituted the phalanx.

Diodorus Siculus, and all the Roman writers who have treated of the hiſtory of Greece, aſſert that Philip, in the firſt year of his reign, inſtituted the Macedonian phalanx; a body of 6000 men armed with ſhort ſwords fitted either for cutting or ſtabbing, having alſo ſtrong bucklers four feet long and two and a half broad, and pikes 14 feet long; uſually marching 16 men deep. But this opinion is controverted by others. Dr Gillies ſuppoſes that the opinion had ariſen from the Romans meeting with the phalanx in its moſt complete form in Macedon; and as they became acquainted with Greece and Macedon pretty nearly at the ſame time, it was natural for them to ſuppoſe that it had been invented among the Macedonians. The phalanx, he ſays, is nothing different from the armour and arrangement which had always prevailed among the Greeks, and which Philip adopted in their moſt perfect form; "nor is there reaſon (ſays he) to think that a prince, who knew the danger of changing what the experience of ages had approved, made any alteration in the weapons or tactics of that people. The improvement in the countermarch, to which Philip gave the appearance of advancing inſtead of retreating, mentioned by Ælian in his Tactics, cap. xxviii. was borrowed, as this author tells us, from the Lacedemonians. If Philip increaſed the phalanx, uſually leſs numerous, to 6000 men, this was far from an improvement; and the latter kings of Macedon, who ſwelled it to 16,000, only rendered that order of battle more unwieldy and inconvenient." Inſtead of this, Philip, according to our author, employed himſelf in procuring arms, horſes, and other neceſſary materials for war; and in introducing a more ſevere and exact military diſcipline than had formerly been known in Macedon.

27 Overcomes the Pæonians and Illyrians.

While the king thus took the beſt methods to render himſelf ſecure at home and formidable abroad, the Pæonians again began to make incurſions into the kingdom. The death of Agis their king, however, who was a man of great military ſkill, deprived them almoſt of every power of reſiſtance when they were attacked. Philip, of conſequence, overran their country with little oppoſition, and reduced them to the ſtate of tributaries to Macedon. No ſooner was this accompliſhed, than he undertook a winter's campaign againſt the Illyrians, who had long been the natural enemies of Macedon. They had now extended their territory to the eaſt; by which means the Macedonians were excluded from the harbours on the coaſt of the Adriatic. This was a grievance to Philip, who ſeems early to have meditated the raiſing of a naval power; neither could he hope to be in ſafety, ſhould the kingdom be left open to the incurſions of a barbarous enemy; for which reaſons he determined at once to humble thoſe enemies in ſuch a manner that they ſhould no longer be in a ſituation to give him any diſturbance. After an ineffectual negociation, he was met by Bardyllis at the head of a conſiderable body of infantry, but with only 400 horſe. They made a gallant reſiſtance for ſome time; but being unable to cope with ſuch a ſkilful general as Philip, they were defeated with the loſs of 7000 men, among whom was their leader Bardyllis, who fell at the age of 90.

28 They are forced to become tributary.

By this diſaſter the Illyrians were ſo much diſheartened, that they ſent ambaſſadors to Philip, humbly begging for peace on any terms. The conqueror granted them the ſame conditions which had been impoſed upon the Pæonians, viz. the becoming tributary, and yielding up to him a conſiderable part of their country. That part of it which lay to the eaſtward of a lake named Lychnidus he annexed to Macedon; and probably built a town and ſettled a colony there; the country being fertile, and the lake abounding with many kinds of fiſh highly eſteemed by the ancients. This town and lake were about 50 miles diſtant from the Ionian ſea; and ſuch was the aſcendancy which the arms and policy of Philip acquired over his neighbours, that the inhabitants of all the intermediate diſtrict ſoon adopted the language and manners of their conquerors; and their territory, hitherto unconnected with any foreign power, ſunk into ſuch abſolute dependence upon Macedon, that many ancient geographers ſuppoſed it to be a province of that country.

29 His great deſigns.

Philip had no ſooner reduced the Illyrians, than he began to put in execution greater deſigns than any he had yet attempted. The rich coaſts to the ſouthward of Macedon, inhabited chiefly by Greeks, preſented a ſtrong temptation to his ambition and avarice. The confederacy of Olynthus, after having thrown off the yoke of Sparta, was become more powerful than ever, and could ſend into the field an army of 10,000 heavy armed troops, beſides a number of cavalry in proportion. Moſt of the towns in Chalcidice were become its allies or ſubjects; ſo that this populous and wealthy province, together with Pangæus on the right and Pieria on the left, of both which the cities were either independent or ſubject to the Athenians, formed a barrier not only ſufficient to guard againſt any incurſions of the Macedonians, but which was even formidable to them.

30 Plans the conqueſt of Amphipolis.

But though Philip was ſenſible enough of the importance of thoſe places, he conſidered the conqueſt of Amphipolis as more neceſſary at the preſent time. By the poſſeſſion of this place Macedon would be connected with the ſea, and would be ſecured in many commercial advantages, which could not but contribute greatly to the proſperity of the kingdom at large; a road was likewiſe opened to the woods and mines of Pangæus, the former of which were ſo neceſſary to the raiſing of a naval power, and the latter for the eſtabliſhment of a proper military force. This city had indeed been declared independent by Philip himſelf in the beginning of his reign; but this was only to prevent a rupture with the Athenians, who ſtill aſſerted their right to it as an ancient colony; though, by reaſon of the perfidy of Charidemus, a native of Eubœa, they had hitherto failed in their attempts to recover it. The Amphipolitans, however, having once enjoyed the ſweets of liberty, prepared to maintain themſelves in their independence. In the mean time the hoſtile deſigns of Philip, which all his precaution had not been able to conceal, alarmed the inhabitants to ſuch a degree, that they thought proper to put themſelves under the protection of the Olynthians. By them they were readily received into to the confederacy; and, truſting to the ſtrength of their new allies, behaved in ſuch an inſolent manner to Philip, that he was not long of finding a ſpecious pretext for hoſtility; at which the Olynthians, greatly alarmed, ſent ambaſſadors to Athens, requeſting their aſſiſtance againſt ſuch a powerful enemy. Philip, however, juſtly alarmed at ſuch a formidable conſpiracy, ſent agents to Athens, with ſuch expedition that they arrived there before any thing could be concluded with the Olynthian deputies. Having gained over the popular leaders and orators, he deceived and flattered the magiſtrates and ſenate in ſuch an artful manner, that a negociation was inſtantly ſet on foot, by which Philip engaged to conquer Amphipolis for the Athenians, upon condition that they ſurrendered to him the ſtrong fortreſs of Pydna, a place which he repreſented as of much leſs importance to them; promiſing alſo to confer upon them many other advantages, which, however, he did not ſpecify at that time. Thus the Athenians, deceived by the perfidy of their own magiſtrates, elated with the hopes of recovering Amphipolis, and outwitted by the ſuperior policy of Philip, rejected with diſdain the proffers of the Olynthians.

31 Engages to conquer it for the Athenians.

The ambaſſadors of Olynthus returned home highly diſguſted with the reception they had met with; but had ſcarce time to communicate the news to their countrymen, when the ambaſſadors of Philip arrived at Olynthus. He pretended to condole with them on the affront they had received at Athens; but teſtified his ſurpriſe that they ſhould court the aſſiſtance of that diſtant and haughty republic, when they could avail themſelves of the powerful kingdom of Macedon, which wiſhed for nothing more than to enter into equal and laſting engagements with their confederacy. As a proof of his moderation and ſincerity, he offered to put them in poſſeſſion of Anthemus, an important town in the neighbourhood, of which the Macedonians had long claimed the juriſdiction, making many other fair promiſes; and among the reſt, that he would reduce for them the cities of Pydna and Potidæa, which he choſe rather to ſee in dependence on Olynthus than Athens. Thus he prevailed upon the Olynthians not only to abandon Amphipolis, but to aſſiſt him with all their power in the execution of his deſigns.

Philip now loſt no time in executing his purpoſes on Amphipolis; and preſſed the city ſo cloſely, that the people were glad to apply to the Athenians for relief. Accordingly they deſpatched two of their moſt eminent citizens, Hierax and Stratocles, to repreſent the danger of an alliance betwixt Philip and the Olynthians, and to profeſs their ſorrow for having ſo deeply offended the parent ſtate. This repreſentation had ſuch an effect, that though the Athenians were then deeply engaged in the Social war, they would probably have paid ſome attention to the Amphipolitans, had not Philip taken care to ſend them a letter with freſh aſſurances of friendſhip, acknowledging their right to Amphipolis, and which he hoped ſhortly to put into their hands in terms of his recent agreement. By theſe ſpecious pretences the Athenians were perſuaded to pay as little regard to the deputies of the Amphipolitans as they had already done to thoſe of the Olynthians; ſo that the city, unable to defend itſelf alone againſt ſo powerful an enemy, ſurrendered at laſt at diſcretion in the year 357 B. C.

32 Amphipolis ſurrenders.

Philip ſtill proceeded in the ſame cautious and politic manner in which he had begun. Though the obſtinate defence of the Amphipolitans might have furniſhed a pretence for ſeverity, he contented himſelf with baniſhing a few of the popular leaders from whom he had moſt cauſe to dread oppoſition, treating the reſt of the inhabitants with all manner of clemency; but took care to add Amphipolis to his own dominions, from which he was determined that it never ſhould be ſeparated, notwithſtanding the promiſes he had made to the Athenians. Finding that it was not his intereſt at this time to fall out with the Olynthians, he cultivated the friendſhip of that republic with great aſſiduity; took the cities of Pydna and Potidæa, which he readily yielded to the Olynthians, though they had given him but little aſſiſtance in the reduction of theſe places. Potidæa had been garriſoned by the Athenians; and them the artful king ſent back without ranſom, lamenting the neceſſity of his affairs which obliged him, contrary to his inclination, to oppoſe their republic. Though this was rather too groſs, the Athenians at preſent were ſo much engaged with the Social war, that they had not leiſure to attend to the affairs of other nations. Philip made the beſt uſe of his time, and next projected the conqueſt of the gold mines of Thrace. That rich and fertile country was now held by one Cotys, a prince of ſuch weak intellectual faculties, that the ſuperſtition of the Greeks, into which he was newly initiated, had almoſt entirely ſubverted his reaſon; and he wandered about in queſt of the goddeſs Minerva, with whom he fancied himſelf in love. The invaſion of the Macedonians, however, awaked him from his reverie; and Cotys, finding himſelf deſtitute of other means of oppoſition, attempted to ſtop the progreſs of the enemy by a letter. To this Philip paid no regard: the Thracians were inſtantly expelled from their poſſeſſions at Crenidæ, where there were very valuable gold mines. Theſe had formerly been worked by colonies from Thaſos and Athens; but the coloniſts had long ſince been expelled by the barbarous Thracians, who knew not how to make uſe of the treaſure they were in poſſeſſion of. Philip took the trouble to deſcend into the mines himſelf, in order to inſpect the works; and having cauſed them to be repaired, planted a Macedonian colony at Crenidæ, beſtowed upon it the name of Philippi, and drew annually from the gold mines to the value of near 1000 talents, or 200,000l. ſterling; an immenſe ſum in thoſe days. The coins ſtruck here were likewiſe called Philippi.

33 Makes himſelf maſter of the gold mines of Thrace.

Philip having obtained this valuable acquiſition, next took upon him to ſettle the affairs of Theſſaly, where every thing was in confuſion. This country had been formerly oppreſſed by Alexander tyrant of Pheræ; after whoſe death three others appeared, viz. Tiſſiphornus, Pitholaus, and Lycophron, the brothers-in-law of Alexander, who had likewiſe murdered him. By the united efforts of the Theſſalians and Macedonians, however, theſe uſurpers were eaſily overthrown, and effectually prevented from making any diſturbances for the future; and the Theſſalians, out of a miſtaken gratitude, ſurrendered to Philip all the revenues ariſing from

34 Settles the affairs of Theſſaly greatly to his advantage.

from their fairs and towns of commerce, as well as all the conveniences of their harbours and ſhipping; a conceſſion which Philip took care to ſecure in the moſt effectual manner.

Having now not only eſtabliſhed his ſovereignty in the moſt effectual manner, but rendered himſelf very powerful and formidable to his neighbours, Philip determined to enjoy ſome repoſe from his fatigues. Having formed an alliance with Arybbas king of Epirus,

35 Marries Olympias.

he, in the year 357 B. C. married Olympias the ſiſter of that prince; a match thought the more eligible, as the kings of Epirus were ſuppoſed to be deſcended from Achilles. The nuptials were ſolemnized at Pella with great pomp, and ſeveral months were ſpent in ſhows and diverſions; during which Philip ſhowed ſuch an extreme proneneſs to vice of every kind, as diſgraced him in the eyes of his neighbours, and moſt probably laid the foundation of his future domeſtic unhappineſs.

36 A general combination of the neighbouring princes formed againſt him.

So much was this behaviour of the Macedonian monarch taken notice of by the neighbouring ſtates, that the Pæonians and Illyrians threw off the yoke, engaging in their ſchemes the king of Thrace: and notwithſtanding the inſane ſtate of that prince, their deſigns were now carried on with more judgement than was uſual with barbarians. Philip, however, notwithſtanding his diſſipation, got warning of his danger in ſufficient time to prevent the bad conſequences which might have enſued had the confederates got time to bring their matters to a proper bearing. Early in the ſpring 356 he took the field with the flower of the Macedonian troops. Having marched in perſon againſt the Pæonians and Thracians, he deſpatched

37 Defeats his enemies.

Parmenio his beſt general into Illyria. Both enterpriſes proved ſucceſsful; and while Philip returned victorious from Thrace, he received an account of the victory gained by Parmenio; a ſecond meſſenger informed him of a victory gained by his chariot at the Olympic games; and a third, that Olympias had been

38 Birth of Alexander the Great.

delivered of a ſon at Pella. This was the celebrated Alexander, to whom the diviners propheſied the higheſt proſperity and glory, as being born in ſuch auſpicious circumſtances.

39 Ariſtotle appointed his preceptor.

A ſhort time after the birth of Alexander, Philip wrote a letter to the philoſopher Ariſtotle, whom he choſe for preceptor to his young ſon. The letter was written with great brevity, containing only the following words: "Know that a ſon is born to us. We thank the gods not ſo much for their gift, as for beſtowing it at a time when Ariſtotle lives. We aſſure ourſelves that you will form him a prince worthy of his father, and worthy of Macedon." He next

40 Extent of the Macedonian territories.

ſet about the farther enlargement of his territories, which were already very conſiderable. Pæonia was now one of his provinces; on the eaſt his dominions extended to the ſea of Thaſos, and on the weſt to the lake Lychnidus. The Theſſalians were in effect ſubject to his juriſdiction, and the poſſeſſion of Amphipolis had ſecured him many commercial advantages; he had a numerous and well-diſciplined army, with

41 Projects the conqueſt of Olynthus and of all Greece.

plentiful reſources for ſupporting ſuch an armament, and carrying through the other ſchemes ſuggeſted by his ambition; though his deep and impenetrable policy rendered him more truly formidable than all theſe put together. His firſt ſcheme was the reduction of Olynthus, the moſt populous and fertile country on the borders of Macedon; after which his ambition prompted him to acquire the ſovereignty of all Greece. To accompliſh the former, he had hitherto courted the friendſhip of the Olynthians by every poſſible method; and without letting ſlip any opportunity to accompliſh the latter, he deprived the Athenians gradually of ſeveral of their ſettlements in Thrace and Macedon. In theſe depredations, however, he took care always to give ſuch appearance of juſtice to his actions, that his antagoniſts, who had ſtudied the matter leſs deeply, could not find a plauſible pretext for engaging in war againſt him, even when he had openly committed hoſtilities againſt them. Philip eaſily perceived that the affairs of the Greeks were coming to a criſis, and he determined to wait the event of their mutual diſſenſions. That event did not diſappoint his hopes. The

42 Account of the Phocian war.

Phocians had violated the religion of thoſe days in a moſt extraordinary manner; they had even ploughed up the lands conſecrated to Apollo: and however they might pretend to excuſe themſelves by examples, the Amphictyons fulminated a decree againſt the Phocians, commanding the ſacred lands to be laid waſte, and impoſing an heavy fine upon the community.

By this decree all Greece was again involved in the war called *Phocian*, from the name of the city about which it commenced. Philip at the beginning of the troubles was engaged in Thrace, where a civil war had taken place among the ſons of Cotys; and wherever Philip interfered, he was ſure to make matters turn out to his own advantage. His encroachments at length became ſo enormous, that Kerſobletes, the moſt powerful of the contending princes, agreed to cede the Thracian Cherſoneſus to the Athenians; who immediately ſent Chares at the head of a powerful armament to take poſſeſſion of it. In this expedition the town of Seſtos was taken by ſtorm, and the inhabitants cruelly treated by Chares, while Philip employed himſelf in the ſiege of Methone in Pieria. This city

43 Philip loſes an eye at the ſiege of Methone.

he likewiſe reduced; but the king loſt an eye at the ſiege in the following extraordinary manner, if we may give credit to ſome ancient hiſtorians. A celebrated archer, named After, had, it ſeems, offered his ſervices to Philip, being repreſented as ſuch an excellent markſman, that he could hit the ſwifteſt bird on the wing. Philip replied, that he would be of excellent uſe if they were to make war with ſtarlings. After, diſguſted with this reception, went over to the enemy, and with an arrow wounded the king in the eye. When the weapon was extracted, it was found to have on it the following inſcription: "For the right eye of Philip." The king ordered the arrow to be ſhot back again, with another inſcription, importing that he would cauſe After to be hanged when the town was taken. A report was raiſed after Philip's death, that he had loſt his eye by prying too narrowly into the amours of Olympias and Jupiter Ammon; which the vanity of his ſucceſſor prompted him to cheriſh, as his flatterers had probably been the inventors of it.

All this time the Phocian war raged with the greateſt fury, and involved in it all the ſtates of Greece. Lycophron, one of the Theſſalian tyrants, whom Philip

44 Is engaged in a war with Onomarchus the Phocian general,

had formerly deprived of his authority, had again found means to re-eſtabliſh his authority, and his countrymen having taken part with the Phocians, Lycophron called in Onomarchus the Phocian general to

proteſt

Macedon.

protect him against the power of Philip, by whom he was sensible that he would soon be attacked. The king accordingly marched into Thessaly with a considerable army, defeated Phyallus the brother of Onomarchus, whom the latter had sent into the country with a detachment of 7000 men. After this he besieged and took the city of Pegasæ, driving the enemy towards the frontiers of Phocis. Onomarchus then advanced with the whole army; and Philip, though inferior in numbers, did not decline the engagement. The Phocians at first gave ground, on which the Macedonians pursued, but in good order; but coming near a precipice, on the top of which Onomarchus had posted a detachment of soldiers, the latter rolled down stones and fragments of the rock in such a manner as did dreadful execution, and threw them into the utmost disorder. Philip, however, rallied his troops with great presence of mind, and prevented the Phocians from gaining any farther advantage than they had already done; saying, as he drew off his men, that they did not retreat through fear, but like rams, in order to strike with the greater vigour. Nor was he long before he made good his assertion; for having recruited his army with the greatest expedition, he returned into Thessaly at the head of 20,000 foot and 500 horse, where he was met by Onomarchus. The Macedonians at this time were superior in number to their enemies; and Philip moreover took care to remind them, that their quarrel was that of heaven, and that their enemies had been guilty of sacrilege, by profaning the temple of Delphi. That they might be still more animated in the cause, he put crowns of laurel on their heads. Thus fired by enthusiasm, and having besides the advantage of numbers, the Phocians were altogether unable to withstand them. They threw away their arms and fled towards the sea, where they expected to have been relieved by Chares, who, with the Athenian fleet, was nigh the shore: but in this they were disappointed, for he made no attempt to save them. Upwards of 6000 perished in the field of battle or in the pursuit, and 3000 were taken prisoners. The body of Onomarchus being found among the slain, was by order of Philip hung upon a gibbet as a mark of infamy, on account of his having polluted the temple; the bodies of the rest were thrown into the sea, as being all partakers of the same crime. The fate of the prisoners is not known, by reason of an ambiguity in a sentence of Diodorus Siculus, which may imply that they were drowned, though it does not expressly say so.

45 who defeats him;

46 but is at last defeated and killed.

47 Philip pursues his ambitious schemes.

After this victory, Philip set about the settlement of Thessaly, waiting only for an opportunity to put in execution his favourite scheme of invading Greece. In the mean time, he rejoiced to see the states weakening each other by their mutual dissensions; of which he never failed to take advantage as far as possible. He now, however, began to throw off the mask with regard to the Olynthians, whom he had long deceived with fair promises. Having detached Kersobletes from the interest of the Athenians, he established him in the sovereignty of Thrace; not out of any good will, but with a view to destroy him whenever a proper opportunity offered. Were he once possessed of the dominions of that prince, the way to Byzantium was open to him; the possession of which must have been a great temptation to Philip, who well knew how to value the importance of its situation both with respect to commerce and war: and in order to pave the way to this important conquest, he attacked the fortress of Heræum, a small and in itself unimportant place, though, by reason of its neighbourhood to Byzantium, the acquisition was valuable to Philip. The Athenians, however, at last began to perceive the designs of Philip, and determined to counteract them. For this purpose they entered into an alliance with Olynthus; and having warned Kersobletes of his danger, they ordered a powerful fleet to the defence of the Heræum. But these vigorous measures were soon counteracted by the report of Philip's death, which had been occasioned by his wound at Methone, and a distemper arising from the fatigues he had afterwards undergone. The inconstant Athenians too easily gave credit to this report; and, as if all danger had been over with his death, discontinued their preparations, and directed their whole attention to the sacred war.—This contest, instead of being ended by the death of Onomarchus, now raged with double fury. Phyallus, above mentioned, the only surviving brother of Onomarchus, undertook the cause of the Phocians; and his affairs becoming every day more and more desperate, he undertook the most unaccountable method of retrieving them which could be imagined: having converted into ready money the most precious materials belonging to the temple at Delphi, and with this treasure doubled the pay of his soldiers. By this new piece of sacrilege, he indeed brought many adventurers to his standard, though he cut off all hopes of mercy for himself or his party should he be defeated. Having the assistance of 1000 Lacedemonians, 2000 Achæans, and 5000 Athenian foot, with 400 cavalry, he was still enabled to make a very formidable appearance; and the Phocians took the field with great prospect of success.

48 Is opposed by the Athenians.

49 Continuation of the Phocian war.

50 Philip engages in the quarrel.

51 Is prevented from entering Greece.

Philip now thought it time to throw off the mask entirely, for which the proceedings of the Athenians, particularly their league with Olynthus, furnished him with a plausible pretext; and the revenging such horrid sacrilege as had been committed at Delphi seemed to give him a title to march at the head of an army into Greece. The superstition of the Greeks, however, had not yet blinded them to such a degree, but they could easily perceive that Philip's piety was a mere pretence, and that his real design was to invade and conquer the whole country. The Athenians no sooner heard of the march of the Macedonian army, than they despatched, with all expedition, a strong guard to secure the pass of Thermopylæ; so that Philip was obliged to return greatly chagrined and disappointed. Their next step was to call an assembly, to deliberate upon the measures proper to be taken in order to restrain the ambition of the Macedonian monarch; and this assembly is rendered memorable by the first appearance of Demosthenes as an orator against Philip. Athens for some time had been in a very alarming situation. They were deeply involved in the sacred war; their northern possessions were continually insulted and plundered by Philip; while a number of his mercenary partisans drew off the public attention to such a degree, that, instead of taking measures to counteract that ambitious prince, they amused

Macedon. mused themselves with speculations about the designs of the Persian monarch, who was preparing for war against the Cyprians, Egyptians, and Phœnicians. Isocrates the celebrated orator, and Phocion the statesman, joined the multitude in their present opinion, though not from any mercenary motives, but purely from a sense of the unsteady conduct of the Athenians; who, they were assured, could not contend with a prince of the vigour and activity of Philip; and therefore exhorted them by all means to cultivate the friendship of Philip, whom they could not oppose with any probability of success. Isocrates, indeed, greatly wished for an expedition into Asia, and looked upon Philip to be the only general capable of conducting it, though at present the Greeks had no pretence for making war upon the Persians, but that of revenging former injuries: and on this subject he addressed a discourse to Philip himself; and it is even said, that Isocrates, by the power of his rhetoric, prevailed upon Philip and the Athenians to lay aside their animosities for a short time, and consent to undertake this expedition in conjunction.

52 Extreme indolence and carelessness of the Athenians.

53 Advice of Isocrates the orator to them.

54 He and Phocion are opposed by Demosthenes.

If this coalition, however, did really take place, it was of very short duration. The views of Phocion and Isocrates were violently opposed by Demosthenes. Though sensible of the corruption and degeneracy of his countrymen, he hoped to be able to rouse them from their lethargy by dint of his eloquence; a talent he had been at great pains to cultivate, and in which he is said to have excelled all men that ever existed.

55 Substance of his first discourses.

In his first addresses to the people, this celebrated orator exhorted them to awake from their indolence, and to assume the direction of their own affairs. They had been too long governed, he said, by the incapacity of a few ambitious men, to the great disadvantage as well as disgrace of the community. In the first place, an orator who had placed himself at the head of a faction of no more than 300 or 400, availed himself and his followers of the carelessness and negligence of the people, to rule them at pleasure. From a consideration of their present weakness and corruption, as well as of the designs and commotions of the neighbouring powers, he advised them to abandon all romantic and distant schemes of ambition; and instead of carrying their arms into remote countries, to prepare for repelling the attacks which might be made upon their own dominions. He insisted also upon a better regulation of their finances, a more equal distribution of the public burdens, in proportion to the abilities of those upon whom they were laid, and upon the retrenching many superfluous expences. Having pointed out in a strong light the vigorous conduct of Philip; and shown by what means he had attained to such a respectable footing in the world, he next laid down a proper plan for their military operations. He told them, that they were not yet prepared to meet Philip in the field; they must begin with protecting Olynthus and the Chersonesus, for which it would be necessary to raise a body of 2000 light armed troops, with a due proportion of cavalry, which ought to be transported under a proper convoy to the islands of Lemnos, Thasos, and Sciathos, in the neighbourhood of Macedon. In these they would enjoy all kinds of necessaries in abundance, and might avail themselves of every favourable incident, to appear at the first summons of their allies; and either to repel the incursions of the Macedonians, or harass their territories. While this was going on, more vigorous preparations might be made for war at home; and it was proposed, that only the fourth part of the Athenian citizens should enlist, and no more supplies were wanted at present but 90 talents. But notwithstanding the moderation of these proposals, and the urgent necessities of the state, it was impossible to prevail upon the indolent and careless Athenians to provide for their own safety. They appear, indeed, at this time to have been desperately sunk in effeminacy and dissipation; which disposition Philip took care to encourage to the utmost of his power. There was an assembly in the city called the *Sixty*, from their consisting originally of that number, who met expressly for the purposes of extinguishing all care about public affairs, and to intoxicate themselves with every kind of pleasure they had in their power. With this assembly Philip was so well pleased, that he sent them money to support their extravagancies; and so effectually did they answer his purposes, that all the eloquence of Demosthenes could not counteract the speeches of orators much his inferiors when backed by Macedonian gold. Macedon.

Philip himself, as we have already hinted, was excessively debauched in his private character, and the most shameful stories are related of him by the ancient writers, particularly by Demosthenes. Theopompus, too, an author who flourished in the time of Alexander, and was rewarded and honoured by that monarch, also speaks of him in such terms as we cannot with decency relate: but these accounts, coming from the avowed enemies of the king, are scarcely to be credited; and perhaps *policy*, as well as inclination, might contribute somewhat to this scandalous behaviour, that he might thereby recommend himself to the libertines of Athens, and prevent even many of the more thinking part of the people from suspecting his designs. But in whatever excesses he might at times indulge himself, he never lost sight of his main object, the subjugation of the Greek states. On pretence of being in want of money to defray the expence of his buildings, he borrowed money at a very high price throughout the whole country; and this he found an easy matter to do, as the dissipation of the Delphic treasures had rendered cash very plentiful in Greece. Thus he attached his creditors firmly to his own interest; and on pretence of paying debts, was enabled without molestation to bestow a number of pensions and gratuities upon the Athenian orators, who by their treacherous harangues contributed greatly to the ruin of their country; at least as far as it could be ruined by subjection to a prince who would have obliged them to remain at peace, and apply themselves to useful arts. These he himself encouraged in a very eminent degree. The greatest part of his time was employed at Pella, which city he adorned in the most magnificent manner with temples, theatres, and porticoes. He invited by liberal rewards, the most ingenious artists in Greece; and as many of these met with very little encouragement in their own country, great numbers flocked to him from all quarters. In the government of his people, also, Philip behaved with the utmost impartiality: listening with condescension to the complaints of the

meanest

Macedon.

meaneſt of his ſubjects, and keeping up a conſtant correſpondence with thoſe whom he thought worthy of his acquaintance; from which, it is not eaſy to imagine how he could be ſo guilty of the vices we have already mentioned from ſome ancient hiſtorians.

The fate of Olynthus was now ſoon determined. This city, which held the balance of power betwixt Athens and Macedon, was taken and plundered, and the inhabitants ſold for ſlaves; but the chief hope of Philip was in putting an end to the Phocian war. For this purpoſe he affected a neutrality, that he might thereby become the arbiter of Greece. His hopes were well founded; for the Thebans, who were at the head of the league againſt the Phocians, ſolicited him on the one ſide, and the ſtates confederate with the Phocians did the like on the other. He anſwered neither, yet held both in dependence. In his heart he favoured the Thebans, or rather placed his hopes of favouring his own cauſe in that ſtate; for he well knew, that the Athenians, Spartans, and other ſtates allied with Phocis, would never allow him to paſs Thermopylæ, and lead an army into their territories. So much reſpect, however, did he ſhow to the ambaſſadors from theſe ſtates, particularly Cteſiphon and Phrynon, who came from Athens, that they believed him to be in their intereſt, and reported as much to their maſters. The Athenians, who were now diſſolved in eaſe and luxury, received this news with great ſatisfaction; and named immediately ten plenipotentiaries to go and treat of a full and laſting peace with Philip. Among theſe plenipotentiaries were Demoſthenes and Æſchines, the moſt celebrated orators in Athens. Philip gave directions that theſe ambaſſadors ſhould be treated with the utmoſt civility; naming, at the ſame time, three of his miniſters to confer with them, viz. Antipater, Parmenio, and Eurylochus. Demoſthenes being obliged to return to Athens, recommended it to his colleagues not to carry on their negociations with Philip's deputies; but to proceed with all diligence to court, there to confer with the king himſelf. The ambaſſadors, however, were ſo far from following his inſtructions, that they ſuffered themſelves to be put off for three months by the arts of Philip and his miniſters.

56 Over-reaches the Athenians, and at laſt concludes a peace.

In the mean time, the king took from the Athenians ſuch places in Thrace as might beſt cover his frontiers; giving their plenipotentiaries, in their ſtead, abundance of fair promiſes, and the ſtrongeſt aſſurances that his good will ſhould be as beneficial to them as ever their colonies had been. At laſt a peace was concluded; but then the ratification of it was deferred till Philip had poſſeſſed himſelf of Pheræ in Theſſaly, and ſaw himſelf at the head of a numerous army: then he ratified the treaty; and diſmiſſed the plenipotentiaries with aſſurances, that he would be ready at all times to give the Athenians proofs of his friendſhip. On their return to Athens, when this matter came to be debated before the people, Demoſthenes plainly told them, that, in his opinion, the promiſes of Philip ought not to be relied on, becauſe they appeared to be of little ſignificance in themſelves, and came from a prince of ſo much art, and ſo little fidelity, that they could derive no authority from their maker. Æſchines, on the other hand, gave it as his ſentiment, that the king of Macedon's aſſurances ought to give them full ſatisfaction. He ſaid, that for his part, he was not politician enough to ſee any thing of diſguiſe or diſſimulation in the king's conduct; that there was great danger in diſtruſting princes; and that the ſureſt method of putting men upon deceit was to ſhow that we ſuſpected them of it. The reſt of the plenipotentiaries concurred with Æſchines; and the people, deſirous of quiet, and addicted to pleaſure, eaſily gave credit to all that was ſaid, and decreed that the peace ſhould be kept. All this was the eaſier brought about, becauſe Phocion, the worthieſt man in the republic, did not oppoſe Philip; which was owing to his having a juſt ſenſe of the ſtate his country was in. He conceived, that the Athenians of thoſe times were nothing like their anceſtors; and therefore, as he expreſſed himſelf on another occaſion, he was deſirous, ſince they would not be at the head of Greece themſelves, that they would at leaſt be upon good terms with that power which would be ſo.

57 Paſſes Thermopylæ, and ends the Phocian war.

Philip, who knew how to uſe as well as to procure opportunity, while the Athenians were in this good humour, paſſed Thermopylæ, without their knowing whether he would fall on Phocis or Thebes; but he quickly undeceived them, by commanding his ſoldiers to put on crowns of laurel, declaring them thereby the troops of Apollo, and himſelf the lieutenant-general of that god. He then entered Phocis with an air of triumph; which ſo terrified the Phocians, whom he had cauſed to be proclaimed ſacrilegious perſons, that they immediately diſmiſſed all thoughts of defence, and without more ado ſubmitted to his mercy. Thus the Phocian war, which had ſo long employed all Greece, was ended without a ſtroke; and the judgement on the Phocians remitted to the Amphictyons, or grand council of Greece. By their decree the walls of three Phocian cities were demoliſhed, the people were forbid to inhabit in any but villages, to pay a yearly tribute of 60 talents, and never to make uſe either of houſes or arms till they had repaid to the temple of Apollo the money they had ſacrilegiouſly carried from thence. Their arms were taken from them, broken to pieces, and burnt; their double voice in the council was taken from them, and given to the Macedonians. Other orders were made for ſettling the affairs both of religion and ſtate throughout Greece: all of which were executed by Philip with great exactneſs and moderation, he paying the moſt profound reſpect to the council; and, when he had performed its commands, retiring peaceably with his army back to Macedon, which gained him great reputation.

58 Is again oppoſed by the Athenians.

At Athens alone, the juſtice and piety of Philip was not underſtood. The people began to ſee, though a little too late, that they had been abuſed and deceived by thoſe who had negociated the late peace. They ſaw that, through their acceptance of it, the Phocians were deſtroyed; that Philip was become maſter of Thermopylæ, and might enter Greece when he pleaſed; that, in abandoning their allies, they had abandoned themſelves; and that, in all probability, they might ſoon feel the weight of his power, whom they had ſo fooliſhly truſted: they therefore began to take new and hoſtile meaſures; they ordered that the women ſhould retire out of the villages into the city, their walls be repaired, and their forts new ſtrengthened.

Macedon.

ed. They ſeemed inclined to queſtion Philip's election into the council of the Amphictyons, becauſe it had been done without their conſent; and even to proceed to an open war. In all likelihood they had carried things to extravagancy, if Demoſthenes had not interpoſed. He told them, that though he was not for making the peace, he was however for keeping it; and that he ſaw no manner of occaſion for their entering into ſo unequal a conteſt as would needs enſue, if they took up arms, not only againſt Philip, but againſt all the ſtates concurring with him in the late tranſactions. This ſeems to have cooled the rage of the Athenians; and to have brought them to think of *ruining* Philip by degrees, as by degrees they had *raiſed* him.

59 Purſues his conqueſts in Thrace.

The fame of his achievements without the bounds of Macedon having diſpoſed the ſubjects of Philip to hope every thing from his conduct, and the ſeveral ſtates of Greece to deſire above all things his friendſhip; that prudent monarch laid hold of this favourable ſituation to fix his dominion on ſuch a ſtable foundation as that a reverſe of fortune ſhould not immediately deſtroy it. To this end, while he carried on his negociations through Greece, he likewiſe kept his army in exerciſe, by taking ſeveral places in Thrace, which terribly incommoded the Athenians.

60 His dominions invaded by Diopithes;

Diopithes, who had the government of the Athenian colonies in thoſe parts, perceiving well what end Philip had in view, did not ſtay for inſtructions from home; but having raiſed with much expedition a conſiderable body of troops, taking advantage of the king's being abſent with his army, entered the adjacent territories of Philip, and waſted them with fire and ſword.

The king, who, on account of the operations of the campaign in the Cherſoneſe, was not at leiſure to repel Diopithes by force, nor indeed could divide his army without imminent hazard, choſe, like an able general, rather to abandon his provinces to inſults, which might be afterwards revenged, than, by following the dictates of an ill-timed paſſion, to hazard the loſs of his veteran army, whereon lay all his hopes. He contented himſelf, therefore, with complaining to the Athenians of Diopithes's conduct, who in a time of peace had entered his dominions, and committed ſuch devaſtations as could ſcarcely have been juſtified in a time of war. His partiſans ſupported this application with all their eloquence. They told the Athenians, that unleſs they recalled Diopithes, and brought him to a trial for this infringement of the peace, they ought not to hope either for the friendſhip of Philip or of any other prince or ſtate; neither could they juſtly complain, if, prompted by ſuch a precedent, others ſhould break faith with them, and fall without the leaſt notice upon their dominions.

61 who is defended by Demoſthenes.

Demoſthenes defended Diopithes; and undertook to ſhow that he deſerved the praiſe and not the cenſure of the Athenians. Thoſe of the other party began then to charge him with crimes of a different nature; they alleged, that he oppreſſed the ſubjects and maltreated the allies of Athens. Demoſthenes replied, that of theſe things there were as yet no proofs; that when ſuch ſhould appear, a ſingle galley might be ſent to bring over Diopithes to abide their judgement, but that Philip would not come if they ſent a fleet: whence he inferred, that they ought to be cautious, and to weigh well the merits of this cauſe before they took any reſolution. He ſaid, that it was true Philip had not as yet attacked Attica, or pretended to make a deſcent on their territories in Greece, or to force his way into their ports; when it came to that, he was of opinion they would be hardly able to defend themſelves; wherefore he thought ſuch men were to be eſteemed as fought to protect their frontiers, in order to keep Philip as long as might be at a diſtance: whereupon he moved, that, inſtead of diſowning what Diopithes had done, or directing him to diſmiſs his army, they ſhould ſend him over recruits, and ſhow the king of Macedon they knew how to protect their territories, and to maintain the dignity of their ſtate, as well as their anceſtors. Theſe arguments had ſuch an effect, that a decree was made conformable to his motion.

Macedon.

While affairs ſtood thus, the Illyrians recovering courage, and ſeeing Philip at ſuch a diſtance, haraſſed the frontiers of Macedon, and threatened a formidable invaſion: but Philip, by quick marches, arrived on the borders of Illyricum; and ſtruck this barbarous people with ſuch a panic, that they were glad to compound for their former depredations at the price he was pleaſed to ſet. Moſt of the Greek cities in Thrace now ſought the friendſhip of the king, and entered into a league with him for their mutual defence. As it cannot be ſuppoſed that each of theſe free cities had a power equal to that of Philip, we may therefore look upon him as their protector. 62

62 Philip's ſchemes defeated.

About this time Philip's negociations in Peloponneſus began to come to light; the Argives and Meſſenians, growing weary of that tyrannical authority which the Spartans exerciſed over them, applied to Thebes for aſſiſtance; and the Thebans, out of their natural averſion to Sparta, ſought to open a paſſage for Philip into Peloponneſus, that, in conjunction with them, he might humble the Lacedemonians. Philip readily accepted the offer; and reſolved to procure a decree from the Amphictyons, directing the Lacedemonians to leave Argos and Meſſene free; which if they complied not with, he, as the lieutenant of the Amphictyons, might, with great appearance of juſtice, march with a body of troops to enforce their order. When Sparta had intelligence of this, ſhe immediately applied to Athens, earneſtly entreating aſſiſtance, as in the common cauſe of Greece. The Argives and Meſſenians, on the other hand, laboured aſſiduouſly to gain the Athenians to their ſide; alleging that, if they were friends to liberty, they ought to aſſiſt thoſe whoſe only aim was to be free. Demoſthenes, at this juncture, outwreſtled Philip, if we may borrow that king's expreſſion; for, by a vehement harangue, he not only determined his own citizens to become the avowed enemies of the king, but alſo made the Argives and Meſſenians not over fond of him for an ally; which when Philip perceived, he laid aſide all thoughts of this enterpriſe for the preſent, and began to practiſe in Eubœa.

This country, now called *Negropont*, is ſeparated from Greece by the Euripus, a ſtrait ſo narrow, that Eubœa might eaſily be united to the continent. This ſituation made Philip call it *the fetters of Greece*, which he therefore ſought to have in his own hands. There had been for ſome years great diſturbances in that country; under colour of which, Philip ſent forces thither, Macedon. thither, and demolished Porthmos, the strongest city in those parts, leaving the country under the government of three lords, whom Demosthenes roundly calls *tyrants*, established by Philip. Shortly after, the Macedonians took Oreus, which was left under the government of five magistrates, styled also *tyrants* at Athens. Thither Plutarch of Eretria, one of the most eminent persons in Eubœa, went to represent the distresses of his country, and to implore the Athenians to set it free. This suit Demosthenes recommended warmly to the people; who sent thither their famous leader Phocion, supported by formidable votes, but a very slender army: yet so well did he manage the affairs of the commonwealth and her allies, that Philip quickly found he must for a time abandon that project; which, however, he did not till he had formed another no less beneficial to himself, or less dangerous to Athens. It was the prosecution of his conquests in Thrace which he thought of pushing much farther than he had hitherto done, or could be reasonably suspected to have any intention of doing.

Extraordinary preparations were made by the Macedonian monarch for this campaign. His son Alexander was left regent of the kingdom; and he himself with 30,000 men laid siege to Perinthus, one of the strongest cities in the country. At present, however, all his arts of cajoling and pretending friendship were insufficient to deceive the Athenians. They gave the command of their army and fleet to Phocion; a general of great abilities, and with whom Philip would have found it very hard to contend. On the other hand, the king of Persia began to turn jealous of the growing power of the Macedonian monarch. The Persian kings had been accustomed to regard those of Macedon as their faithful allies; but the good fortune of Philip, the continual clamour of the Athenians against him, and his dethroning at pleasure the petty princes of Thrace, made him now regarded in another light. When therefore he led his troops against Perinthus, *the Great King*, as he was styled by the Greeks, sent his letters mandatory to the governors of the maritime provinces, directing them to supply the place with all things in their power; in consequence of which they filled it with troops, granted subsidies in ready money, and sent besides great convoys of provision and ammunition. The Byzantines also, supposing their own turn would be next, exerted their utmost endeavours for the preservation of Perinthus; sending thither the flower of their youth, with all other necessaries for an obstinate defence. The consequence of all this was, that Philip found himself obliged to raise the siege with great loss.

63 How he at last gained his point.

That the reputation of the Macedonian arms might not sink by this disgrace, Philip made war on the Scythians and Triballi, both of whom he defeated; and then formed a design of invading Attica, though he had no fleet to transport his troops, and knew very well that the Thessalians were not to be depended upon if he attempted to march through the Pisæ, and that the Thebans would even then be ready to oppose his march. To obviate all these difficulties, he had recourse to Athens itself; where by means of his partisans, he procured his old friend Æschines to be sent their deputy to the Amphictyons. This seemed a small matter, and yet was the hinge on which his whole project turned. By that time Æschines had taken his seat, a question was stirred in the council, whether the Locrians of Amphisia had not been guilty of sacrilege in ploughing the fields of Cyrrha in the neighbourhood of the temple of Delphi. The assembly being divided in their opinions, Æschines proposed to take a view; which was according decreed. But when the Amphictyons came in order to see how things stood, the Locrians, either jealous of their property, or spurred thereto by the suggestions of some who saw farther than themselves, fell upon those venerable persons so rudely, that they were compelled to secure themselves by flight. The Amphictyons decreed, that an army should be raised, under the command of one of their own number, to chastise the delinquents; but as this army was to be composed of troops sent from all parts of Greece, the appearance at the rendezvous was so inconsiderable, that the Amphictyons sent to command them durst undertake nothing. The whole matter being reported to the council, Æschines, in a long and eloquent harangue, showed how much the welfare and even the safety of Greece depended on the deference paid to their decrees; and after inveighing against the want of public spirit in such as had not sent their quotas at the time appointed by the council, he moved that they should elect Philip for their general, and pray him to execute their decree. The deputies from the other states, conceiving that by this expedient their respective constituents would be free from any farther trouble or expence, came into it at once; whereupon a decree was immediately drawn up, purporting that ambassadors should be sent to Philip of Macedon, in the name of Apollo and the Amphictyons, once more to require his assistance, and to notify to him, that the states of Greece had unanimously chosen him their general, with full power to act as he thought fit against such as had opposed the authority of the Amphictyons. Thus of a sudden Philip acquired all that he sought; and having an army ready in expectation of this event, he immediately marched to execute the commands of the Amphictyons in appearance, but in reality to accomplish his own designs: For having passed into Greece with his army, instead of attacking the Locrians, he seized immediately upon Elatea, a great city of Phocis upon the river Cephisus.

64 Is chosen general by the Amphictyons.

65 Is opposed by the Athenians and Thebans;

The Athenians in the mean time were in the utmost confusion on the news of Philip's march. However, by the advice of Demosthenes, they invited the Thebans to join them against the common enemy of Greece. Philip endeavoured as much as possible to prevent this confederacy from taking place; but all his efforts proved ineffectual. The Athenians raised an army, which marched immediately to Eleusis, where they were joined by the Thebans. The confederates made the best appearance that had ever been seen in Greece, and the troops were exceedingly good; but unfortunately the generals were men of no conduct or skill in the military art. An engagement ensued at Cheronæa; wherein Alexander commanded one wing of the Macedonian army, and his father Philip the other. The confederate army was divided according to the different nations of which it consisted; the Athenians having the right and the Bœotians the left. In the beginning of the battle the confederates had the better; whereupon

66 whom he defeats at Cheronæa.

upon Stratocles an Athenian commander cried out, "Come on, brother ſoldiers, let us drive them back to Macedon;" which being overheard by the king, he ſaid very coolly to one of his officers, "Theſe Athenians do not know how to conquer." Upon this he directed the files of the phalanx to be ſtraitened; and drawing his men up very cloſe, retired to a neighbouring eminence: from whence, when the Athenians were eager in their purſuit, he ruſhed down with impetuoſity, broke, and routed them with prodigious ſlaughter. The orator Demoſthenes behaved very unbecomingly in this engagement; for he deſerted his poſt, and was one of the firſt that fled: nay, we are told, that a ſtake catching hold of his robe, he, not doubting but it was an enemy, cried out, "Alas! ſpare my life."

67
Is appointed general againſt the Perſians.

This victory determined the fate of Greece; and from this time we muſt reckon Philip ſupreme lord of all the Grecian ſtates. The firſt uſe he made of his power was to convoke a general aſſembly, wherein he was recognized generaliſſimo, and with full power appointed their leader againſt the Perſians. Having, by virtue of his authority, ſettled a general peace among them, and appointed the quota that each of the ſtates ſhould furniſh for the war, he diſmiſſed them: and returning to Macedon, began to make great preparations for this new expedition. His pretence for making war on the Perſians at this time was the aſſiſtance given by the Perſians to the city of Perinthus, as already mentioned. In the mean time, however, the king by reaſon of the diſſenſions which reigned in his family, was made quite miſerable. He quarrelled with his wife Olympias to ſuch a degree, that he divorced her, and married another woman named *Cleopatra*. This produced a quarrel between him and his ſon Alexander; which alſo came to ſuch a height, that Alexander retired into Epirus with his mother. Some time afterwards, however, he was recalled, and a reconciliation took place in appearance; but in the mean time a conſpiracy was formed againſt the king's life, the circumſtances and cauſes of which are very much unknown. Certain it is, however, that it took effect, as the king was exhibiting certain ſhows in honour of his daughter's marriage with the king of Epirus. Philip, having given a public audience to the ambaſſadors of Greece, went next day in ſtate to the theatre. All the ſeats were early taken up; and the ſhows began with a ſplendid proceſſion, wherein the images of the 12 ſuperior deities of Greece were carried, as alſo the image of Philip, habited in like manner, as if he now made the 13th, at which the people ſhouted aloud. Then came the king alone, in a white robe, crowned, with his guards at a conſiderable diſtance, that the Greeks might ſee he placed his ſafety only in his confidence of the loyalty of his ſubjects. Pauſanias, the aſſaſſin, however, had fixed himſelf cloſe by the door of the theatre; and obſerving that all things fell out as he had foreſeen they would, took his opportunity when the king drew near him, and plunging his ſword in his left ſide, laid him dead at his feet. He then fled as faſt as he was able towards the place where his horſes were; and would have eſcaped, had not the twig of a vine catched his ſhoe and thrown him down. This gave time to thoſe who purſued him to come up with him; but inſtead of ſecuring him, in order to extort a diſcovery of his accomplices, they put an end to his life.

68
Is murdered.

69
His character.

With regard to the character of this monarch, it appears certain, that he was one of the moſt eminent perſons that ever ſat on a throne. Had he lived for ſome time longer, he would in all probability have ſubdued the Perſians: which was in truth leſs difficult than what he had already done. "Had that event taken place (ſays Dr Gillies), the undertakings of his long and ſucceſsful reign would have been ennobled and illuminated by the ſplendour of extenſive foreign conqueſt. Philip would have reached the height of ſuch renown as is obtained by the habits of activity, vigilance, and fortitude, in the purſuit of unbounded greatneſs; and in the opinion of poſterity, would perhaps have ſurpaſſed the glory of all kings and conquerors who either preceded or followed him. Yet, even on this ſuppoſition, there is not any man of ſenſe and probity, who, if he allows himſelf time for ſerious reflection, would purchaſe the imagined grandeur and proſperity of the king of Macedon at the price of his artifices and his crimes; and to a philoſopher, who conſidered either the means by which he had obtained his triumphs, or the probable conſequences of his dominion over Greece and Aſia, the buſy ambition of this mighty conqueror would appear but a deceitful ſcene of ſplendid miſery."

70
Extravagant joy of the Athenians.

No ſooner did the news of Philip's death reach Athens, than, as if all danger had been paſt, the inhabitants ſhowed the moſt extravagant ſigns of joy. Demoſthenes and his party put on chaplets of flowers, and behaved as if they had gained a great victory. Phocion reproved them for this madneſs; bidding them remember, that "the army which had beaten them at Cheronæa was leſſened but by one." This reproof, however, had very little effect. The people heard with pleaſure all the harſh things which the orators could ſay of the young Alexander king of Macedon, whom they repreſented as a giddy wrong-headed boy, ready to graſp all things in his imagination, and able to perform nothing. The affairs of Macedon indeed were in a very diſtracted ſtate on the acceſſion of Alexander: for all the neighbouring nations had the ſame notion of the young king with the Athenians; and being irritated by the uſurpations of Philip, immediately revolted; and the ſtates of Greece entered into a confederacy againſt him. The Perſians had been contriving to transfer the war into Macedon; but as ſoon as the news of Philip's death reached them, they behaved as if all danger had been over. At the ſame time Attalus, one of the Macedonian commanders, aſpired to the crown, and ſought to draw off the ſoldiers from their allegiance.

In the councils held on this occaſion, Alexander's beſt friends adviſed him rather to make uſe of diſſimulation than force, and to cajole thoſe whom they thought he could not ſubdue. Theſe advices, however, were ill ſuited to the temper of their monarch. He thought that vigorous meaſures only were proper, and therefore immediately led his army into Theſſaly. Here he harangued the princes ſo effectually, that he thoroughly gained them over to his intereſt, and was by them declared general of Greece; upon which he returned to Macedon, where he cauſed Attalus to be ſeized and put to death.

71
Alexander declared general of Greece.

Macedon.

In the ſpring of the next year (335 B. C.) Alexander reſolved to ſubdue the Triballians and Illyrians, who inhabited the countries now called *Bulgaria* and *Sclavonia*, and had been very formidable enemies to the Macedonian power. In this expedition he diſcovered, though then but 20 years of age, a ſurpriſing degree of military knowledge. Having advanced to the paſſes of Mount Hæmus, he found that the barbarians had poſted themſelves in the moſt advantageous manner. On the tops of the cliffs, and at the head of every paſſage, they had placed their carriages and waggons in ſuch a manner as to form a kind of parapet with their ſhafts inwards, that when the Macedonians ſhould have half aſcended the rock, they might be able to puſh theſe heavy carriages down upon them. They reckoned the more upon this contrivance, becauſe of the cloſe order of the phalanx, which, they imagined, would be terribly expoſed by the ſolders wanting room to ſtir, and thereby avoid the falling waggons. But Alexander, having directed his heavy armed troops to march, gave orders, that, where the way would permit, they ſhould open to the right and left, and ſuffer the carriages to go through; but that, in the narrow paſſes, they ſhould throw themſelves on their faces with their ſhields behind them, that the carts might run over them. This had the deſired effect; and the Macedonians reached the enemies works without the loſs of a man. The diſpute was then quickly decided; the barbarians were driven from their poſts with great ſlaughter, and left behind them a conſiderable booty for the conquerors.

72 Defeats the Triballi.

The next exploits of Alexander were againſt the Getæ, the Tanlantii, and ſome other nations inhabiting the country on the other ſide of the Danube. Them he alſo overcame; ſhowing in all his actions the moſt perfect ſkill in military affairs, joined with the greateſt valour. In the mean time, however, all Greece was in commotion by a report which had been confidently ſpread abroad, that the king was dead in Illyria. The Thebans, on this news, ſeized Amyntas and Timolaus, two eminent officers in the Macedonian garriſon which held their citadel, and dragged them to the market-place, where they were put to death without either form or proceſs, or any crime alleged againſt them. Alexander, however, did not ſuffer them to remain long in their miſtake. He marched with ſuch expedition, that in ſeven days he reached Pallene in Theſſaly; and in ſix days more he entered Bœotia, before the Thebans had any intelligence of his paſſing the ſtraits of Thermopylæ. Even then they would not believe that the king was alive; but inſiſted that the Macedonian army was commanded by Antipater, or by one Alexander the ſon of Æropus. The reſt of the Greeks, however, were not ſo hard of belief; and therefore ſent no aſſiſtance to the Thebans, who were thus obliged to bear the conſequences of their own folly and obſtinacy. The city was taken by ſtorm, and the inhabitants were for ſome hours maſſacred without diſtinction of age or ſex; after which the houſes were demoliſhed, all except that of Pindar the famous poet, which was ſpared out of reſpect to the merit of its owner, and becauſe he had celebrated Alexander I. king of Macedon. The lands, excepting thoſe deſtined to religious uſes, were ſhared among the ſoldiers, and all the priſoners ſold for ſlaves; by which 440 talents were brought into the king's treaſury.

73 The Thebans revolt on the news of his death.

74 Thebes taken and deſtroyed.

Macedon.

By this ſeverity the reſt of the Grecian ſtates were ſo thoroughly humbled, that they thought no more of making any reſiſtance, and Alexander had nothing further to hinder him from his favourite project of invading Aſia. Very little preparation was neceſſary for the Macedonian monarch, who went out as to an aſſured conqueſt, and reckoned upon being ſupplied only by the ſpoils of his enemies. Hiſtorians are not agreed as to the number of his army: Arrian ſays, that there were 30,000 foot and 5000 horſe. Diodorus Siculus tells us, that there were 13,000 Macedonian foot, 7000 of the confederate ſtates, and 5000 mercenaries. Theſe were under the command of Parmenio. Of the Odriſians, Triballians, and Illyrians, there were 5000; and of the Agrians, who were armed only with darts, 1000. As for the horſe, he tells us there were 1800 commanded by Philotas, and as many Theſſalians under the command of Callas: out of the confederate ſtates of Greece, were 600 commanded by Eurygius; and 900 Thracians and Pæonians, who led the van under Caſſander. Plutarch tells us, that, according to a low computation, he had 30,000 foot and 5000 horſe; and, according to the largeſt reckoning, he had 34,000 foot and 4000 horſe. As to his fund for the payment of the army, Ariſtobulus ſays it was but 70 talents; and Oneſicritus, who was alſo in this expedition, not only takes away the 70 talents, but affirms that the king was 200 in debt. As for proviſions, there was juſt ſufficient for a month and no more; and to prevent diſturbances, Antipater was left in Macedon with 12,000 foot and 1500 horſe.

75 Number of the army with which he invaded Aſia.

The army having aſſembled at Amphipolis, he marched from thence to the mouths of the river Strymon; then croſſing Mount Pangæus, he took the road to Abdera. Croſſing the river Ebrus, he proceeded through the country of Pætis, and in 20 days reached Seſtos; thence he came to Eleus, where he ſacrificed on the tomb of Proteſilaus, becauſe he was the firſt among the Greeks who at the ſiege of Troy ſet foot on the Aſiatic ſhore. He did this, that his landing might be more propitious than that of the hero to whom he ſacrificed, who was ſlain ſoon after. The greateſt part of the army, under the command of Parmenio, embarked at Seſtos, on board a fleet of 160 galleys of three benches of oars, beſides ſmall craft. Alexander himſelf ſailed from Eleus; and when he was in the middle of the Helleſpont, offered a bull to Neptune and the Nereids, pouring forth at the ſame time a libation from a golden cup. When he drew near the ſhore, he launched a javelin, which ſtuck in the earth: then, in complete armour, he leaped upon the ſtrand; and having erected altars to Jupiter, Minerva, and Hercules, he proceeded to Ilium. Here again he ſacrificed to Minerva; and taking down ſome arms which had hung in the temple of that goddeſs ſince the time of the Trojan war, conſecrated his own in their ſtead. He ſacrificed alſo to the ghoſt of Priam, to avert his wrath on account of the deſcent which he himſelf claimed from Achilles.

76 Sets out on his expedition.

In the mean time the Perſians had aſſembled a great army in Phrygia; among whom was one Memnon a Rhodian, the beſt officer in the ſervice of Darius. Alexander,

lexander, as ſoon as he had performed all the ceremonies which he judged neceſſary, marched directly towards the enemy. Memnon gave it as his opinion, that they ſhould burn and deſtroy all the country round, that they might deprive the Greeks of the means of ſubſiſting, and then tranſport a part of their army into Macedon. But the Perſians, depending on their cavalry, rejected this ſalutary advice; and poſted themſelves along the river Granicus, in order to wait the arrival of Alexander. In the engagement which happened on the banks of that river, the Perſians were defeated †, and Alexander became maſter of all the neighbouring country; which he immediately began to take care of, as if it had been part of his hereditary

77 Conſequences of his firſt victory.

dominions. The city of Sardis was immediately delivered up; and here Alexander built a temple to Jupiter Olympius. After this, he reſtored the Epheſians to their liberty; ordered the tribute which they formerly paid to the Perſians to be applied towards the rebuilding the magnificent temple of Diana: and having ſettled the affairs of the city, marched againſt Miletus. This place was defended by Memnon with a conſiderable body of troops who had fled thither after the battle of Granicus, and therefore made a vigorous reſiſtance. The fortune of Alexander, however, prevailed; and the city was ſoon reduced, though Memnon with part of the troops eſcaped to Halicarnaſſus. After this, the king diſmiſſed his fleet, for which various reaſons have been aſſigned; though it is probable, that the chief one was to ſhow his army that their only reſource now was in ſubverting the Perſian empire.

† See *Granicus.*

Almoſt all the cities between Miletus and Halicarnaſſus ſubmitted as ſoon as they heard that the former was taken; but Halicarnaſſus, where Memnon commanded with a very numerous garriſon, made an obſtinate defence. Nothing, however, was able to reſiſt the Macedonian army. Memnon was at laſt obliged to abandon the place; upon which Alexander took and razed the city of Tralles in Phrygia; received the ſubmiſſion of ſeveral princes tributary to the Perſians; and having deſtroyed the Marmarians, a people of Lycia who had fallen upon the rear of his army, put an end to the campaign; after which he ſent home all the new married men; in obedience, it would ſeem, to a precept of the Moſaic law, and which endeared him more to his ſoldiers than any other action of his life.

As ſoon as the ſeaſon would permit, Alexander quitted the province of Phaſelus; and having ſent part of his army through the mountainous country to Perga, by a ſhort but difficult road, took his route by a certain promontory, where the way is altogether impaſſable, except when the north winds blow. At the time of the king's march the ſouth wind had held for a long time; but of a ſudden it changed, and blew from the north ſo violently, that, as he and his followers declared, they obtained a ſafe and eaſy paſſage through the Divine aſſiſtance. By many this march is held to be miraculous, and compared to that of the children of Iſrael through the Red ſea; while, on the other hand, it is the opinion of others, that there was nothing at all extraordinary in it. He continued his march towards Gordium, a city of Phrygia; the enemy having abandoned the ſtrong paſs of Telmiſſus, through which it was neceſſary for him to march. When he arrived at Gordium, and found himſelf under a neceſſity of ſtaying ſome time there till the ſeveral corps of his army could be united, he expreſſed a ſtrong deſire of ſeeing Gordius's chariot, and the famous knot in the harneſs, of which ſuch ſtrange ſtories had been publiſhed to the world. The cord in which this knot was tied, was made of the inner rind of the cornel tree; and no eye could perceive where it

78 Unties the Gordian knot.

had begun or ended. Alexander, when he could find no poſſible way of untying, and yet was unwilling to leave it tied leſt it ſhould cauſe ſome fears in the breaſts of his ſoldiers, is ſaid by ſome authors to have cut the cords with his ſword, ſaying, "It matters not how it is undone." But Ariſtobulus aſſures us, that the king wreſted a wooden pin out of the beam of the waggon, which, being driven in acroſs the beam, held it up; and ſo took the yoke from under it. Be this as it will, however, Arrian informs us, that a great tempeſt of thunder, lightning, and rain, happening the ſucceeding night, it was held declarative of the true ſolution of this knot, and that Alexander ſhould become lord of Aſia.

The king having left Gordium, marched towards Cilicia; where he was attended with his uſual good fortune, the Perſians abandoning all the ſtrong paſſes as he advanced. As ſoon as he entered the province, he received advice that Arſames, whom Darius had made governor of Tarſus, was about to abandon it, and that the inhabitants were very apprehenſive that he intended to plunder them before he withdrew. To prevent this, the king marched inceſſantly, and arrived

79 His ſickneſs and recovery.

juſt in time to ſave the city. But his ſaving it had well nigh coſt him his life: for, either through the exceſſive fatigue of marching, as ſome ſay, or, according to others, by his plunging when very hot into the river Cydnus, which, as it runs through thick ſhades, has its waters exceſſively cold, he fell into ſuch a diſtemper as threatened his immediate diſſolution. His army loſt their ſpirits immediately; the generals knew not what to do; and his phyſicians were ſo much affrighted, that the terror of his death hindered them from uſing the neceſſary methods for preſerving his life. Philip the Acarnanian alone preſerved temper enough to examine the nature of the king's diſeaſe; the worſt ſymptom of which was a continual waking, and which he took off by means of a potion, and in a ſhort time the king recovered his uſual health.

Soon after Alexander's recovery, he received the agreeable news that Ptolemy and Aſander had defeated the Perſian generals, and made great conqueſts on the Helleſpont; a little after that, he met the Perſian army at Iſſus, commanded by Darius himſelf. A bloody engagement enſued, in which the Perſians were defeated with great ſlaughter, as related under the article Issus. The conſequences of this victory were very advantageous to the Macedonians. Many governors of provinces and petty princes ſubmitted themſelves to the conqueror; and ſuch as did ſo were treated, not as a newly conquered people, but as his old hereditary ſubjects; being neither burdened with ſoldiers nor oppreſſed with tribute. Among the number of thoſe places which, within a ſhort ſpace after the battle of Iſſus, ſent deputies to ſubmit to the conqueror, was the city of Tyre. The king, whoſe name was Azelmicus,

micus, was abſent in the Perſian fleet; but his ſon was among the deputies, and was very favourably received by Alexander. The king probably intended to confer particular honours on the city of Tyre; for he acquainted the inhabitants that he would come and ſacrifice to the Tyrian Hercules, the patron of their city, to whom they had erected a moſt magnificent temple. But theſe people, like moſt other trading nations, were too ſuſpicious to think of admitting ſuch an enterpriſing prince with his troops within their walls. They ſent therefore their deputies again to him, to inform him, that they were ready to do whatever he ſhould command them; but, as to his coming and ſacrificing in their city, they could not conſent to that, but were poſitively determined not to admit a ſingle Macedonian within their gates. Alexander immediately diſmiſſed their deputies in great diſpleaſure. He then aſſembled a council of war, wherein he inſiſted ſtrongly on the diſaffected ſtate of Greece (for moſt of the Grecian ſtates had ſent ambaſſadors to Darius, to enter into a league with him againſt the Macedonians), the power of the Perſians by ſea, and the folly of carrying on the war in diſtant provinces, while Tyre was left unreduced behind them: he alſo remarked, that if once this city was ſubdued, the ſovereignty of the ſea would be transferred to them, becauſe it would fix their poſſeſſion of the coaſts; and as the Perſian fleet was compoſed chiefly of tributary ſquadrons, thoſe tributaries would fight the battles,
80 not of their late, but of their preſent maſters. For
Tyre taken and deſtroyed. theſe reaſons the ſiege of Tyre was reſolved on. The town was not taken, however, without great difficulty; which provoked Alexander to ſuch a degree, that he treated the inhabitants with the greateſt cruelty. See TYRE.

After the reduction of Tyre, Alexander, though the ſeaſon was already far advanced, reſolved to make an expedition into Syria; and in his way thither propoſed to chaſtiſe the Jews, who had highly offended him during the ſiege of Tyre: for when he ſent to them to demand proviſions for his ſoldiers, they anſwered, That they were the ſubjects of Darius, and bound by oath not to ſupply his enemies. The king, however, was pacified by their ſubmiſſion; and not only pardoned them, but conferred many privileges upon them, as re-
81 lated under the article JEWS.

Egypt ſubmits. From Jeruſalem Alexander marched directly to Gaza, the only place in that part of the world which ſtill held out for Darius. This was a very large and ſtrong city, ſituated on a high hill, about five miles from the ſea-ſhore. One *Batis* or *Betis*, an eunuch, had the government of the place; and had made every preparation neceſſary for ſuſtaining a long and obſtinate ſiege. The governor defended the place with great valour, and ſeveral times repulſed his enemies; but at laſt it was taken by ſtorm, and all the garriſon ſlain to a man; and this ſecured to Alexander an entrance into Egypt, which having before been very impatient of the Perſian yoke, admitted the Macedonians
82 peaceably.

Alexander viſits the temple of Jupiter Ammon. Here the king laid the foundations of the city of Alexandria, which for many years after continued to be the capital of the country. While he remained here, he alſo formed the extraordinary deſign of viſiting the temple of Jupiter Ammon. As to the motives by which he was induced to take this extraordinary journey, authors are not agreed; but certain it is, that he hazarded himſelf and his troops in the higheſt degree; there being two dangers in this march, which, with the example of Cambyſes, who loſt the greateſt part of his army in it, might have terrified any body but Alexander. The firſt was the want of water, which, in the ſandy deſerts ſurrounding the temple, is nowhere to be found; the other, the uncertainty of the road from the fluctuation of the ſands; which changing their ſituation every moment, leave the traveller neither a road to walk in nor mark to march by. Theſe difficulties, however, Alexander got over; though not without a miraculous interpoſition, as is pretended by all his hiſtorians.

Alexander having conſulted the oracle, and received a favourable anſwer, returned to purſue his conqueſts. Having ſettled the government of Egypt, he appointed the general rendezvous of his forces at Tyre. Here he met with ambaſſadors from Athens, requeſting him to pardon ſuch of their countrymen as he found ſerving the enemy. The king, being deſirous to oblige ſuch a famous ſtate, granted their requeſt; and ſent alſo a fleet to the coaſt of Greece, to prevent the effects of ſome commotions which had lately happened in Peloponneſus. He then directed his march to Thapſacus; and having paſſed the Euphrates and Tigris, met with Darius near Arbela, where the Perſians were again overthrown with prodigious ſlaughter †, and Alexander in effect became maſter of the Perſian empire.

† See *Arbela*.

83
After this important victory, Alexander marched directly to Babylon, which was immediately delivered up; the inhabitants being greatly diſaffected to the Perſian intereſt. Reduces Babylon, Suſa, and Perſepolis. After 30 days ſtay in this country, the king marched to Suſa, which had already ſurrendered to Philoxenus; and here he received the treaſures of the Perſian monarch, amounting, according to the moſt generally received account, to 50,000 talents. Having received alſo at this time a ſupply of 6000 foot and 500 horſe from Macedon, he ſet about reducing the nations of Media, among whom Darius was retired. He firſt reduced the Uxians, and having forced a paſſage to Perſepolis the capital of the empire, he like a barbarian deſtroyed the ſtately palace there, a pile of building not to be equalled in any part of the world; after having given up the city to be plundered by his ſoldiers. In the palace he found 120,000 talents, which he appropriated to his own uſe, and cauſed immediately to be carried away upon mules and camels; for he had ſuch an extreme averſion to the inhabitants of Perſepolis, that he determined to leave nothing valuable in the city.

During the time that Alexander remained at Perſepolis, he received intelligence that Darius remained at Ecbatana the capital of Media; upon which he 84
purſued him with the greateſt expedition, marching at the rate of near 40 miles a-day. In 15 days he He purſues Darius; reached Ecbatana, where he was informed that Darius had retired from thence five days before, with an intent to paſs into the remoteſt provinces of his empire. This put ſome ſtop to the rapid progreſs of the Macedonian army; and the king, perceiving that there was no neceſſity for hurrying himſelf and his ſoldiers in ſuch a manner, began to give the orders requiſite in the preſent ſituation of his affairs. The Theſſalian horſe,

Macedon. horse, who had deserved exceedingly well of him in all his battles, he dismissed according to his agreement; gave them their whole pay, and ordered 2000 talents over and above to be distributed among them. He then declared that he would force no man: but if any were willing to serve him longer for pay, he desired they would enter their names in a book, which a great many of them did; the rest sold their horses, and prepared for their departure. The king appointed Epocillus to conduct them to the sea, and assigned him a body of horse as an escort: he likewise sent Menetes with them, to take care of their embarkation, and that they were safely landed in Eubœa without any expence to themselves.

On receiving fresh information concerning the state of Darius's affairs, the king set out again in pursuit of him, advancing as far as Rhages, a city one day's journey from the Caspian straits: there he understood that Darius had passed those straits some time before; which information leaving him again without hopes, he halted for five days. Oxidates, a Persian whom Darius had left prisoner at Susa, was made governor of Media, while the king departed on an expedition into Parthia. The Caspian straits he passed immediately without opposition; and then gave directions to his officers to collect a quantity of provisions sufficient to serve his army on a long march through a wasted country. But before his officers could accomplish those commands, the king received intelligence that Darius had been murdered by Bessus, one of his own subjects, and governor of Bactria, as is related at length under the article PERSIA.

85 who is murdered.

86 Alexander reduces Hyrcania.

As soon as Alexander had collected his forces together, and settled the government of Parthia, he entered Hyrcania; and having, according to his usual custom, committed the greatest part of his army to the care of Craterus, he, at the head of a choice body of troops, passed through certain craggy roads, and before the arrival of Craterus, who took an open and easy path, struck the whole provinces with such terror, that all the principal places were immediately put into his hands, and soon after the province of Aria also submitted, and the king continued Satibarzanes the governor in his employment.—The reduction of this province finished the conquest of Persia; but the ambition of Alexander to become master of every nation of which he had the least intelligence, induced him to enter the country of the Mardi, merely because its rocks and barrenness had hitherto hindered any body from conquering, or indeed from attempting to conquer it. This conquest, however, he easily accomplished, and obliged the whole nation to submit to his pleasure. But in the mean time disturbances began to arise in Alexander's new empire, and among his troops, which all his activity could not thoroughly suppress. He had scarcely left the province of Aria, when he received intelligence, that the traitor Bessus had caused himself to be proclaimed king of Asia by the name of *Artaxerxes;* and that Satibarzanes had joined him, after having massacred all the Macedonians who had been left in the province. Alexander appointed one *Arsames* governor in the room of Satibarzanes; and marched thence with his army against the *Zarangæ*, who, under the command of Barzaentes, one of those who had conspired against Darius, had taken up arms, and threatened to make an obstinate defence. But their numbers daily falling off, Barzaentes being afraid they would purchase their own safety at the expence of his, privately withdrew from his camp, and, crossing the river Indus, sought shelter among the nations beyond it. But they, either dreading the power of Alexander, or detesting the treachery of this Persian towards his former master, seized and delivered him up to Alexander, who caused him immediately to be put to death.

87 The Macedonians give themselves up to luxury.

The immense treasure which the Macedonians had acquired in the conquest of Persia began now to corrupt them. The king himself was of a most generous disposition, and liberally bestowed his gifts on those around him; but they made a bad use of his bounty, and foolishly indulged in those vices by which the former possessors of that wealth had lost it. The king did all in his power to discourage the lazy and inactive pride which now began to show itself among his officers; but neither his discourses nor his example had any considerable effect. The manners of his courtiers from bad became worse, in spite of all he could say or do to prevent it; and at last they proceeded to censure his conduct, and to express themselves with some bitterness on the subject of his long continuance of the war, and his leading them constantly from one labour to another. This came to such a height, that the king was at last obliged to use some severity, in order to keep his army within the limits of their duty.

88 Alexander conforms to the Persian customs.

From this time forward, however, Alexander himself began to alter his conduct; and by giving a little into the customs of the Orientals, endeavoured to secure that obedience from his new subjects which he found so difficult to be preserved among his old ones. He likewise endeavoured, by various methods, to blend the customs of the Asiatics and the Greeks. The form of his civil government resembled that of the ancient Persian kings: in the military affairs however, he preserved the Macedonian discipline; but then he made choice of 30,000 boys out of the provinces, whom he caused to be instructed in the Greek language, and directed to be brought up in such a manner as that from time to time he might with them fill up the phalanx. The Macedonians saw with great concern these extraordinary measures, which suited very ill with their gross understandings; for they thought, after all the victories they had gained, to be absolute lords of Asia, and to possess not only the riches of its inhabitants, but to rule the inhabitants themselves: whereas they now saw, that Alexander meant no such thing; but that, on the contrary, he conferred governments, offices at court, and all other marks of confidence and favour, indiscriminately both on Greeks and Persians.—From this time also the king seems to have given instances of a cruelty he had never shown before. Philotas his most intimate friend was seized, tortured, and put to death for a conspiracy of which it could never be proved that he was guilty; and soon after Parmenio and some others were executed without any crime at all real or alledged. These things very much disturbed the army. Some of them wrote home to Macedon of the king's suspicions of his friends, and his disposition to hunt out enemies at the very extremities of the world. Alexander having intercepted some of these letters, and

procured

procured the beſt information he could concerning their authors, picked out theſe diſſatisfied people, and having diſpoſed them into a corps, gave it the title of the *turbulent battalion;* hoping by this means to prevent the ſpirit of diſaffection from pervading the whole army.

As a farther precaution againſt any future conſpiracy, Alexander thought fit to appoint Hephæſtion and Clytus generals of the auxiliary horſe; being apprehenſive, that if this authority was lodged in the hands of a ſingle perſon, it might prompt him to dangerous undertakings, and at the ſame time furniſh him with the means of carrying them into execution. To keep his forces in action, he ſuddenly marched into the country of the Euergetæ, i. e. *Benefactors;* and found them full of that kind and hoſpitable diſpoſition for which that name had been beſtowed on their anceſtors: he therefore treated them with great reſpect; and at his departure added ſome lands to their dominions, which lay contiguous, and which for that reaſon they had requeſted of him.

Turning then to the eaſt, he entered Arachoſia, the inhabitants of which ſubmitted without giving him any trouble. While he paſſed the winter in theſe parts, the king received advice, that the Arians, whom he had ſo lately ſubdued, were again up in arms, Satibarzanes being returned into that country with two thouſand horſe aſſigned him by Beſſus. Alexander inſtantly deſpatched Artabazus the Perſian, with Erigyus and Caranus, two of his commanders, with a conſiderable body of horſe and foot; he likewiſe ordered

89 Satibarzanes defeated and killed.

Phrataphernes, to whom he had given the government of Parthia, to accompany them. A general engagement enſued, wherein the Arians behaved very well, as long as their commander Satibarzanes lived; but he engaging Erigyus, the Macedonian ſtruck him firſt into the throat, and then, drawing forth his ſpear again, through the mouth; ſo that he immediately expired, and with him the courage of his ſoldiers, who inſtantly began to fly; whereupon Alexander's commanders made an eaſy conqueſt of the reſt of the country, and ſettled it effectually under his obedience.

The king, notwithſtanding the inclemency of the ſeaſon, advanced into the country of Paropamiſus, ſo called from the mountain Paropamiſus, which the ſoldiers of Alexander called *Caucaſus.* Having croſſed the country in 16 days, he came at length to an opening leading into Media; which finding of a ſufficient breadth, he directed a city to be built there, which he called *Alexandria,* as alſo ſeveral other towns about a day's journey diſtant from thence: and in theſe places he left 7000 perſons, part of them ſuch as had hitherto followed his camp, and part of the mercenary ſoldiers, who, weary of continual fatigue, were content to dwell there. Having thus ſettled things in this province, ſacrificed ſolemnly to the gods, and appointed Proexes the Perſian preſident thereof with a ſmall body of troops under the command of Niloxenus to aſſiſt him, he reſumed his former deſign of penetrating into Bactria.

90 Beſſus reduced and put to death.

Beſſus, who had aſſumed the title of *Artaxerxes,* when he was aſſured that Alexander was marching towards him, immediately began to waſte all the country between Paropamiſus and the river Oxus; which river he paſſed with all his forces, and then burnt all the veſſels he had made uſe of for tranſporting them, retiring to Nautaca, a city of Sogdia; fully perſuaded, that, by the precautions he had taken, Alexander would be compelled to give over his purſuit. This conduct of his, however, diſheartened his troops, and gave the lie to all his pretenſions; for he had affected to cenſure Darius's conduct, and had charged him with cowardice, in not defending the rivers Euphrates and Tigris, whereas he now quitted the banks of the moſt defenſible river perhaps in the whole world. As to his hopes, though it cannot be ſaid they were ill founded, yet they proved abſolutely vain; for Alexander, continuing his march, notwithſtanding all the hardſhips his ſoldiers ſuſtained, reduced all Bactria under his obedience, particularly the capital Bactria and the ſtrong caſtle Aornus: in the latter he placed a garriſon under the command of Archelaus; but the government of the province he committed to Artabazus. He then continued his march to the river Oxus: on the banks of which when he arrived, he found it three quarters of a mile over, its depth more than proportionable to its breadth, its bottom ſandy, its ſtream ſo rapid as to render it almoſt unnavigable, and neither boat nor tree in its neighbourhood; ſo that the ableſt commanders in the Macedonian army were of opinon that they ſhould be obliged to march back. The king, however, having firſt ſent away, under a proper eſcort, all his infirm and worn-out ſoldiers, that they might be conducted ſafe to the ſea-ports, and from thence to Greece, deviſed a method of paſſing this river without either boat or bridge, by cauſing the hides which covered the ſoldiers tents and carriages to be ſtuffed with ſtraw, and then tied together, and thrown into the river. Having croſſed the Oxus, he marched directly towards the camp of Beſſus, where, when he arrived, he found it abandoned; but received at the ſame time letters from Spitamenes and Dataphernes, who were the chief commanders under Beſſus, ſignifying, that, if he would ſend a ſmall party to receive Beſſus, they would deliver him into his hands; which they did accordingly, and the traitor was put to death in the manner related in the hiſtory of Persia.

A ſupply of horſes being now arrived, the Macedonian cavalry were remounted. Alexander continued his march to Maracanda the capital of Sogdia, from whence he advanced to the river Iaxartes. Here he performed great exploits againſt the Scythians; from whom, however, though he overcame them, his army ſuffered much; and the revolted Sogdians being headed by Spitamenes, gave him a great deal of trouble. Here he married Roxana the daughter of Oxyartes, a prince of the country whom he had ſubdued. But during theſe expeditions, the king greatly diſguſted his army by the murder of his friend Clytus in a drunken quarrel at a banquet, and by his extravagant vanity in claiming divine honours. 91 Alexander marries Roxana.

92 Paſſes the Indus.

At laſted he arrived at the river Indus, where Hephæſtion and Perdiccas had already provided a bridge of boats for the paſſage of the army. The king refreſhed his troops for 30 days in the countries on the other ſide of the river, which were thoſe of his friend and ally Taxiles, who gave him 30 elephants, and joined his army now with 700 Indian horſe, to which, when they were to enter upon action, he afterwards added 5000 foot, Macedon. foot. The true reason of this seems to have been his enmity to Porus, a famous Indian prince whose territories lay on the other side of the river Hydaspes. During this recess, the king sacrificed with great solemnity; receiving also ambassadors from Ambisurus, a very potent prince, and from Doxareas, who was likewise a king in those parts, with tenders of their duty, and considerable presents. These ceremonies over, Alexander appointed Philip governor of Taxila, and put a Macedonian garrison into the place, because he intended to erect an hospital there for the cure of his sick and wounded soldiers. He then ordered the vessels, of which his bridge had been composed when he passed the Indus, to be taken to pieces, that they might be brought to the Hydaspes, where he was informed that Porus with a great army lay encamped to hinder his passage. When he approached the banks of this river with his army and the auxiliaries under the command of Taxiles, he found that the people he had to do with were not so easily to be subdued as the Persians and other Asiatics. The Indians were not only a very tall and robust, but also a very hardy and well disciplined people; and their king Porus was a prince of high spirit, invincible courage, and great conduct.

It was about the summer solstice when Alexander reached the Hydaspes, and consequently its waters were broader, deeper, and more rapid, than at any other time; for in India the rivers swell as the sun's increasing heat melts the snow, and subside again as winter approaches. Alexander therefore had every difficulty to struggle with. Porus had made his dispositions so judiciously, that Alexander found it impossible to practise upon him as he had done upon others, and to pass the river in this view: wherefore he was constrained to divide his army into small parties, and to practise other arts, in order to get the better of so vigilant a prince. To this end he caused a great quantity of corn and other provisions to be brought into his camp; giving out, that he intended to remain where he was till the river fell, and by becoming fordable should give him an opportunity of forcing a passage: this did not, however, hinder Porus from keeping up very strict discipline in his camp; which when Alexander perceived, he frequently made such motions as seemed to indicate a change of his resolution, and that he had still thoughts of passing the river. The main thing the Macedonians stood in fear of were the elephants; for the bank being pretty steep on the other side, and it being the nature of horses to start at the first appearance of those animals, it was foreseen that the army would be disordered, and incapable of sustaining the charge of Porus's troops.

93 And the Hydaspes with difficulty.

At length Alexander passed the river by the following contrivance. There was, at the distance of 150 stadia from his camp, a rocky promontory projecting into the river, thick covered with wood; and overagainst this promontory there lay a pretty large uninhabited island almost overgrown with trees. The king therefore conceived within himself a project of conveying a body of troops from this promontory into that island; and upon this scheme he built his hopes of surprising Porus, vigilant as he was. To this end he kept him and his army constantly alarmed for many nights together, till he perceived that Porus apprehended it was only done to harass his troops, and therefore no longer drew out of his camp, but trusted to his ordinary guards: then Alexander resolved to put his design in execution. A considerable body of horse, the Macedonian phalanx, with some corps of light-armed foot, he left in his camp under the command of Craterus, as also the auxiliary Indians, giving these orders, to be observed in his absence, that if Porus marched against him with part of his army, and left another part with the elephants behind in his camp, Craterus and his forces should remain where they were; but if it so happened that Porus withdrew his elephants, then Craterus was to pass the river, because his cavalry might then do it safely. Alexander having marched half the way, or about nine of our miles, ordered the mercenary troops under the command of Attalus and other generals, to remain there; and directed them, that as soon as they knew he was engaged with the Indians on the other side, they should pass in vessels provided for that purpose, in order to assist him. Then marching a long way about, that the enemy might not perceive his design of reaching the rock, he advanced as diligently as he could towards that post. It happened very fortunately for him, that a great storm of thunder, lightning, and hail, rose in the night, whereby his march was perfectly concealed, his vessels of 30 oars put together, and his tents stuffed and stitched, so that they passed from the rock into the island, without being perceived, a little before break of day; the storm ceasing just as he and his soldiers were ready for their passage. When they had traversed the island, they boldly set forward to gain the opposite shore in sight of Porus's outguards, who instantly posted away to give their master an account of the attempt. Alexander landed first himself, and was followed as expeditiously as possible by his forces, whom he took care to draw up as fast as they arrived. When they began their march again, they found that their good fortune was not so great as at first they esteemed it; for it appeared now, that they had not reached the continent at all, but were in truth in another island much larger than the former. They crossed it as fast as they could, and found that it was divided from the *terra firma* by a narrow channel, which, however, was so swelled by the late heavy rain, that the poor soldiers were obliged to wade up to the breast. When they were on the other side, the king drew them up again carefully, ordering the foot to march slowly, they being in number about 6000, while himself with 5000 horse advanced before. As soon as Porus received intelligence that Alexander was actually passing the river, he sent his son with 2000 horse and 120 armed chariots, to oppose him. But they came too late: Alexander was already got on shore, and even on his march.

94 The son of Porus defeated and killed.

When the Macedonian scouts perceived them advance, they informed the king, who sent a detachment to attack them, remaining still at the head of his cavalry in expectation of Porus. But when he found that this party was unsupported, he instantly attacked with all his horse, and defeated them with the slaughter of many, and the loss of all their armed chariots, the son of Porus being slain in the fight. The remainder of the horse returning to the camp with this disastrous account, Porus was in some confusion: however, he took very quickly the best and wisest resolutions his circumstances would allow: which were, to to leave a party of his army, with some of his elephants, to oppose Craterus, who was now about to pass the river also; and, with the rest, to march against Alexander and his forces, who were already passed. This resolution once taken, he marched immediately out of his camp at the head of 4000 horse, 30,000 foot, 300 chariots, and 200 elephants. He advanced as expeditiously as he could, till he came into a plain which was firm and sandy, where his chariots and elephants might act to advantage: there he halted, that he might put his army in order, knowing well that he need not go in quest of his enemy. Alexander soon came up with his horse, but he did not charge Porus; on the contrary, he halted, and put his troops in order, that they might be able to defend themselves in case they were attacked. When he had waited some time, his foot arrived; whom he immediately surrounded with his horse, that, after so fatiguing a march, they might have time to cool and breathe themselves, before they were led to engage. Porus permitted all this, because it was not his interest to fight, and because he depended chiefly upon his order of battle, the elephants covering his foot, so that the Macedonians could not charge them.

95 Porus himself defeated.

When Alexander had disposed his foot in proper order, he placed his horse on the wings: and, observing that he was much superior in them to the enemy, and that the cavalry of Porus were easy to be charged, he resolved to let the foot have as little share as possible in the battle. To this end, having giving the necessary directions to Cœnus who commanded them, he went himself to the right, and with great fury fell upon the left wing of Porus. The dispute, though short, was very bloody: the cavalry of Porus, though they fought gallantly, were quickly broken; and the foot being by this means uncovered, the Macedonians charged them. But the Indian horse rallying, came up to their relief, yet were again defeated. By this time the archers had wounded many of the elephants, and killed most of their riders, so that they did not prove less troublesome and dangerous to their own side than to the Macedonians; whence a great confusion ensued: and Cœnus, taking this opportunity, fell on with the troops under his command, and entirely defeated the Indian army. Porus himself behaved with the greatest intrepidity, and with the most excellent conduct: he gave his orders and directed every thing, as long as his troops retained their form; and when they were broken, he retired from party to party as they made stands, and continued fighting till every corps of Indians was put to the rout. In the mean time Craterus had passed with the rest of the Macedonian army; and these, falling upon the flying Indians, increased the slaughter of the day excessively, insomuch that 20,000 foot and 3000 horse were killed, all the chariots were hacked to pieces, and the elephants not killed were taken; two of Porus's sons fell here, as also most of his officers of all ranks.

As for Porus, Alexander gave strict directions that no injury might be done to his person: he even sent Taxiles to persuade him to surrender himself, and to assure him that he should be treated with all the kindness and respect imaginable; but Porus, disdaining this advice from the mouth of an old enemy, threw a javelin at him, and had killed him but for the quick turn of his horse. Meroe the Indian, who was also in the service of Alexander, succeeded better: he had been the old acquaintance of Porus; and therefore when he entreated that prince to spare his person, and to submit himself to fortune and a generous victor, Porus followed his advice; and we may truly say, that the condition of this Indian king suffered nothing by the loss of the battle. Alexander immediately gave him his liberty, restored him shortly after to his kingdom, to which he annexed provinces almost equal to it in value. Neither was Alexander a loser by his munificence; for Porus remained his true friend and constant ally.

96 He submits to Alexander.

To perpetuate the memory of this victory, Alexander ordered two cities to be erected; one on the field of battle, which he named *Nicæa;* the other on this side the river, which he called *Bucephala*, in honour of his horse Bucephalus, who died here, as Arrian says, of mere old age, being on the verge of 30. All the soldiers who fell in the battle, he buried with great honours; offered solemn sacrifices to the gods, and exhibited pompous shows on the banks of the Hydaspes, where he had forced his passage. He than entered the territories of the Glausæ, in which were 37 good cities, and a multitude of populous villages. All these were delivered up to him without fighting; and as soon as he received them, he presented them to Porus; and having reconciled him to Taxiles, he sent the latter home to his own dominions. About this time ambassadors arrived from some Indian princes with their submissions: and Alexander having conquered the dominions of another Porus, which lay on the Hydraotes, a branch of the Indus, added them to those of Porus his ally.

In the middle of all this success, however, news arrived, that the Cathei, the Oxydracæ, and the Malli, the most warlike nations of India, were confederated against the Macedonians, and had drawn together a great army. The king immediately marched to give them battle; and in a few days reached a city called *Sangala*, seated on the top of a hill, and having a fine lake behind it. Before this city the confederate Indians lay encamped, having three circular lines of carriages locked together, and their tents pitched in the centre. Notwithstanding the apparent difficulty of forcing these intrenchments, Alexander resolved immediately to attack them. The Indians make a noble defence; but at last the first line of their carriages was broken, and the Macedonians entered. The second was stronger by far; yet Alexander attacked that too, and after a desperate resistance forced it. The Indians, without trusting to the third, retired into the city; which Alexander would have invested: but the foot he had with him not being sufficient for that purpose, he caused his works to be carried on both sides as far as the lake; and, on the other side of that, ordered several brigades of horse to take post; ordering also battering engines to be brought up, and in some places employing miners. The second night, he received intelligence that the besieged, knowing the lake to be fordable, intended to make their escape through it. Upon this the king ordered all the carriages which had been taken in forcing their camp to be placed up and down the roads, in hopes of hindering their flight; giving directions to Ptolemy, who commanded

97 Sangala taken.

Macedon.

commanded the horse on the other side of the lake, to be extremely vigilant, and to cause all his trumpets to sound, that the forces might repair to that post where the Indians made their greatest effort. These precautions had all the effect that could be desired: for of the few Indians who got through the lake, and passed the Macedonian horse, the greater part were killed on the roads; but the greatest part of their army was constrained to retire again through the water into the city. Two days after, the place was taken by storm. Seventeen thousand Indians were killed; 70,000 taken prisoners; with 300 chariots, and 500 horse. The Macedonians are said to have lost only 100 men in this siege; but they had 1200 wounded, and among these several persons of great distinction.

The city was no sooner taken, than Alexander despatched Eumenes his secretary, with a party of horse, to acquaint the inhabitants of the cities adjacent with what had befallen the Sangalans; promising also, that they should be kindly treated if they would submit. But they were so much affrighted at what had happened to their neighbours, that, abandoning all their cities, they fled into the mountains; choosing rather to expose themselves to wild beasts, than to these invaders, who had treated their countrymen so cruelly. When the king was informed of this, he sent detachments of horse and foot to scour the roads; and these, finding aged, infirm, and wounded people, to the number of about 500, put them to the sword without

98 And razed.

mercy. Perceiving that it was impossible to persuade the inhabitants to return, he caused the city of Sangala to be razed, and gave the territories to the few Indians who had submitted to him.

Alexander, still unsated with conquest, now prepared to pass the Hyphasis. The chief reason which induced him to think of this expedition was, the information he had received of the state of the countries beyond that river. He was told that they were in themselves rich and fruitful; that their inhabitants were not only a very martial people, but very civilized; that they were governed by the nobility, who were themselves subject to the laws; and that as they lived in happiness and freedom, it was likely they would fight obstinately in defence of those blessings. He was farther told, that among these nations there were the largest, strongest, and most useful elephants bred and tamed; and was therefore fired with an earnest desire to reduce such a bold and brave people under his rule, and of attaining to the possession of the many valuable things that were said to be amongst them. As exorbitant, however, as his personal ambition was, he found it impossible to infuse any part of it into the minds of his soldiers; who were so far from wishing to triumph over new and remote countries, that they were highly desirous of leaving those that they had

99 Alexander's troops refuse to proceed further.

already conquered. When therefore they were informed of the king's intentions, they privately consulted together in the camp about the situation of their own affairs. At this consultation, the gravest and best of the soldiers lamented that they were made use of by their king, not as lions, who fall fiercely upon those who have injured them; but as mastiffs, who fly upon and tear those who are pointed out to them as enemies. The rest were not so modest; but expressed themselves roundly against the king's humour for leading them from battle to battle, from siege to siege, and from river to river; protesting that they would follow him no further, nor lavish away their lives any longer, to purchase fame for him.

Alexander was a man of too much penetration not to be early in perceiving that his troops were very uneasy. He therefore harangued them from his tribunal; but though his eloquence was great, and the love his army had for him was yet very strong, they did not relent. For some time the soldiers remained sullen and silent; and at last turned their eyes on Cœnus, an old and experienced general, whom Alexander loved, and in whom the army put great confidence.—He had the generosity to undertake their cause; and told Alexander frankly, "That men endured toil in hopes of repose; that the Macedonians were already much reduced in their numbers; that of those who remained, the greater part were invalids; and that they expected, in consideration of their former services, that he would now lead them back to their native country: an act which, of all others, would most contribute to his own great designs; since it would encourage the youth of Macedon, and even of all Greece, to follow him in whatever new expedition he pleased to undertake." The king was far from being pleased with this speech of Cœnus, and much less with the disposition of his army, which continued in a deep silence. He therefore dismissed the assembly: but next day he called another, wherein he told the soldiers plainly, that he would not be driven from his purpose; that he would proceed in his conquests with such as should follow him voluntarily; as for the rest, he would not detain them, but would leave them at liberty to go home to Macedon, where they might publish, "that they had left their king in the midst of his enemies." Even this expedient had no success; his army was so thoroughly tired with long marches and desperate battles, that they were determined to go no further, either for fair speeches or foul. Upon this Alexander retired to his tent, where he refused to see his friends, and put on the same gloomy temper that reigned among his troops. For three days things remained in this situation. At last the king suddenly appeared; and, as if he had been fully determined to pursue his first design, he gave orders for sacrificing for the good success of his new undertaking. Aristander the augur reported, that the omens were altogether inauspicious; upon which the king said, that since his proceeding farther was neither pleasing to the gods, nor grateful to his army, he would return. When this was rumoured among the army, they assembled in great numbers about the royal tent, saluting the king with loud acclamations, wishing him success in all his future designs; giving him at the same time hearty thanks, for that "he who was invincible had suffered himself to be overcome by their prayers."

100 He consents to return.

A stop being thus put to the conquests of Alexander, he determined to make the Hyphasis the boundary of his dominions; and having erected twelve altars of an extraordinary magnitude, he sacrificed on them: after which he exhibited shows in the Grecian manner; and, having added all the conquered country in these parts to the dominions of Porus, he began

Macedon.

began to return. Having arrived at the Hydaſpes, he made the neceſſary preparations for ſailing down the Indus into the ocean. For this purpoſe, he ordered vaſt quantities of timber to be felled in the neighbourhood of the Hydaſpes, through which he was to ſail into the Indus; he cauſed the veſſels with which he had paſſed other rivers to be brought thither, and aſſembled a vaſt number of artificers capable of repairing and equipping his fleet; which, when finiſhed, conſiſted of 80 veſſels of three banks of oars, and 2000 leſſer ſhips and tranſports. Thoſe who were to manage this fleet were collected out from the Phœnicians, Cyprians, Carians, and Egyptians following his army, and who were reckoned perfectly well ſkilled in the naval art. When all things were ready, the army embarked about break of day; the king, in the mean time, ſacrificing to the gods according to the ceremonies uſed in his own country, and likewiſe according to thoſe of the country where he now was. Then he himſelf went on board; and cauſing the ſignal to be given by ſound of trumpet, the fleet ſet ſail. Craterus and Hephæſtion had marched ſome days before with another diviſion of the army; and in three days the fleet reached that part of the river which was oppoſite to their camps. Here he had information, that the Oxydracæ and Malli were raiſing forces to oppoſe him; upon which he immediately determined to reduce them; for, during this voyage, he made it a rule to compel the inhabitants on both ſides of the river to yield him obedience. But before he arrived on the coaſts of the people above mentioned, he himſelf ſuſtained no ſmall danger; for, coming to the confluence of the Aceſines with the Hydaſpes, from whence both rivers roll together into the Indus, the eddies, whirlpools, and rapid currents, ruſhing with tremendous noiſe from the reſpective channels of thoſe rivers into the great one formed by them both, at once terrified thoſe who navigated his veſſels, and actually deſtroyed many of the long veſſels, with all who were aboard of them; the king himſelf being in ſome danger, and Nearchus the admiral not a little at a loſs. As ſoon as this danger was over, Alexander went on ſhore; and having ordered his elephants with ſome troops of horſe and archers to be carried acroſs, and put under the command of Craterus, he then divided his army on the left hand bank into three bodies; the firſt commanded by himſelf, the ſecond by Hephæſtion, and the third by Ptolemy. Hephæſtion had orders to move ſilently through the heart of the country, five days march before the king; that if, on Alexander's approach, any of the barbarians ſhould attempt to ſhelter themſelves by retiring into the country, they might fall into the hands of Hephæſtion. Ptolemy Lagus was ordered to march three days journey behind the king, that if any eſcaped his army, they might fall into Ptolemy's hands; and the fleet had orders to ſtop at the confluence of this river with the Hydraotes till ſuch time as theſe ſeveral corps ſhould arrive.

101 Sails down the Indus.

102 His expedition againſt the Malli.

Alexander himſelf, at the head of a body of horſe and light armed foot, marched through a deſert country againſt the Malli; and, ſcarce affording any reſt to his ſoldiers, arrived in three days at a city into which the barbarians had put their wives and children, with a good garriſon for their defence. The country people, having no notion that Alexander would march through ſuch a deſert and barren region, were all unarmed, and in the utmoſt confuſion. Many of them therefore were ſlain in the field; the reſt fled into the city, and ſhut the gates. But this only protracted their fate for a ſhort time; for the king, having ordered the city to be inveſted by his cavalry, took it, as well as the caſtle, by ſtorm, and put all he found there to the ſword. He ſent at the ſame time Perdiccas with a conſiderable detachment, to inveſt another city of the Malli at a conſiderable diſtance; but when he came there, he found it abandoned. However, he purſued the inhabitants who had but lately left it, and killed great numbers of them on the road. After this the king took ſeveral other cities, but not without conſiderable reſiſtance; for the Indians ſometimes choſe to burn themſelves in their houſes rather than ſurrender. At laſt he marched to their capital city; and finding that abandoned, he proceeded to the river Hydraotes, where he found 50,000 men encamped on the oppoſite bank, in order to diſpute his paſſage. He did not heſitate, however, to enter the river with a conſiderable party of horſe: and ſo much were the Indians terrified at his preſence, that their whole army retired before him. In a ſhort time they returned and attacked him, being aſhamed to fly before ſuch an inconſiderable number; but in the mean time the reſt of the Macedonian forces came up, and the Indians were obliged to retire to a city which lay behind them, and which Alexander inveſted that very night. The next day he ſtormed the city with ſuch violence, that the inhabitants were compelled to abandon it, and to retire to the caſtle, where they prepared for an obſtinate defence. The king inſtantly gave orders for ſcaling the walls, and the ſoldiers prepared to execute theſe orders as faſt as they could; but the king being impatient caught hold of a ladder and mounted it firſt himſelf, being followed by Leonatus, Peuceſtas, and Abreas, the latter a man of great valour, and who on that account had double pay allowed him. The king having gained the top of the battlements, cleared them quickly of the defendants, killing ſome of them with his ſword, and puſhing others over the walls: but after this was done, he was in more danger than ever; for the Indians galled him with their arrows from the adjacent towers, though they durſt not come near enough to engage him. His own battalion of targeteers mounting in haſte to ſecond him, broke the ladders; which, as ſoon as Alexander perceived, he threw himſelf down into the caſtle, as did alſo Peuceſtas, Leonatus, and Abreas. As ſoon as the king was on the ground, the Indian general ruſhed forward to attack him; but Alexander inſtantly deſpatched him, as well as ſeveral others who followed him. Upon this the reſt retired, and contented themſelves with throwing darts and ſtones at him at a diſtance. Abreas was ſtruck into the head with an arrow, and died on the ſpot; and, ſhortly after, another pierced through the king's breaſtplate into his body. As long as he had ſpirits, he defended himſelf valiantly; but, through a vaſt effuſion of blood, loſing his ſenſes, he fell upon his ſhield. Peuceſtas then covered him with the ſacred ſhield of Pallas on one ſide, as did Leonatus with his own ſhield on the other, though they themſelves were dreadfully

103 His deſperate valour, and danger.

dreadfully wounded. In the mean time, however, the ſoldiers on the outſide, eager to ſave their king, ſupplied their want of ladders, by driving large iron pins

104 Is with difficulty ſaved by his men.

into the walls. By the help of theſe many of them aſcended, and came to the aſſiſtance of Alexander and his companions. The Indians were now ſlaughtered without mercy; but Alexander continued for ſome time in a very dangerous way: however, he at laſt recovered his ſtrength, and ſhowed himſelf again to his army, which filled them with the greateſt joy.

The Malli, being now convinced that nothing but ſubmiſſion could ſave the remainder of them, ſent deputies to Alexander, offering the dominion of their country; as did alſo the Oxydracæ: and the king having ſettled every thing in theſe countries agreeable

105 He proceeds in his voyage down the Indus.

to his mind, proceeded on his voyage down the river Indus. In this voyage he received the ſubmiſſion of ſome other Indian princes; and perceiving, that at the point of the iſland Pattala, the river divided itſelf into two vaſt branches, he ordered an haven and convenient docks to be made there for his ſhips; and when he had careened his fleet, he ſailed down the right hand branch towards the ocean. In his paſſage he ſuſtained great difficulties by reaſon of his want of pilots, and at the mouth of the river very narrowly miſſed being caſt away: yet all this did not hinder him from purſuing his firſt deſign, though it does not appear that he had any other motive thereto than the vain deſire of boaſting that he had entered the ocean beyond the Indus: for, having conſecrated certain bulls to Neptune, and thrown them into the ſea, performed certain libations of golden cups, and thrown the cups alſo into the ſea, he came back again; having only ſurveyed two little iſlands, one at the mouth of the Indus, and one a little farther in the ocean.

On the king's return to Pattala, he reſolved to ſail down the other branch of the Indus, that he might ſee whether it was more ſafe and commodious for his fleet than that which he had already tried; and for this he had very good reaſons. He had reſolved to ſend Nearchus with his fleet by ſea, through the Perſian gulf up the river Tigris, to meet him and his army in Meſopotamia; but as the poſſibility of this voyage depended on the ceaſing of the Eteſian winds, there was a neceſſity of laying up the fleet till the ſeaſon ſhould prove favourable. Alexander, therefore, ſailing through this branch of the Indus, ſought on the ſea coaſt for bays and creeks, where his fleet might anchor in ſafety; he cauſed alſo pits to be ſunk, which might be filled with freſh water for the uſe of his people; and took all imaginable precautions for preſerving them in eaſe and ſafety till the ſeaſon would allow them to continue their voyage. In this he ſucceeded to his wiſh; for he found this branch of the river Indus, at its mouth, ſpread over the plain country, and forming a kind of lake, wherein a fleet might ride with ſafety. He therefore appointed Leonatus, and a part of his army, to carry on ſuch works as were neceſſary: cauſing them to be relieved by freſh troops as often as there was occaſion: then having

106 Sets out for Babylon.

given his laſt inſtructions to Nearchus, he departed with the reſt of the army, in order to march back to Babylon.

Before the king's departure, many of his friends advised him againſt the route which he intended to take. They told him, that nothing could be more raſh or dangerous than this reſolution. They acquainted him, that the country through which he was to travel was a wild uncultivated deſert; that Semiramis, when ſhe led her ſoldiers this way out of India, brought home but 20 of them; and that Cyrus, attempting to do the ſame, returned with only ſeven. But all this was ſo far from deterring Alexander, that it more than ever determined him to purſue no other road. As ſoon, therefore, as he had put things in order, he marched at the head of a ſufficient body of troops to reduce the Oritæ, who had never vouchſafed either to make their ſubmiſſion or to court his friendſhip. Their territories lay on the other ſide of a river called *Arabis*, which Alexander croſſed ſo ſpeedily, that they had no intelligence of his march; whereupon moſt of them quitted their country, and fled into the deſerts. Their capital he found ſo well ſituated, that he reſolved to take it out of their hands, and to cauſe a new and noble city to be founded there, the care of which he committed to Hephæſtion. Then he received the deputies of the Oritæ and Gedroſi; and having aſſured them, that if the people returned to their villages, they ſhould be kindly treated, and having appointed Apollophenes preſident of the Oritæ, and left a conſiderable body of troops under Leonatus to ſecure their obedience, he began his march through Gedroſia. In this march his troops ſuffered incredible hardſhips. The 107 His dangerous march through Gedroſia.
road was very uncertain and troubleſome, on account of its lying through deep and looſe ſands, riſing in many places into hillocks, which forced the ſoldiers to climb, at the ſame time that it ſunk under their feet; there were no towns, villages, nor places of refreſhment, to be met with; ſo that, after exceſſive marches, they were forced to encamp among theſe dry ſands. As to proviſions, they hardly met with any during their whole march. The ſoldiers were therefore obliged to kill their beaſts of carriage; and ſuch as were ſent to bring ſome corn from the ſea ſide, were ſo grievouſly diſtreſſed, that, though it was ſealed with the king's ſignet, they cut open the bags, chooſing rather to die a violent death for diſobedience than periſh by hunger. When the king, however, was informed of this, he freely pardoned the offenders; he was alſo forced to accept the excuſes that were daily made for the loſs of mules, horſes, &c. which were in truth eaten by the ſoldiers, and their carriages broken in pieces to avoid further trouble. As for water, their want of it was a great misfortune; and yet their finding it in plenty was ſometimes a greater: for, as by the firſt they periſhed with thirſt, ſo by the latter they were burſt, thrown into dropſies, and rendered incapable of travel. Frequently they met with no water for the whole day together: ſometimes they were diſappointed of it at night; in which caſe, if they were able, they marched on; ſo that it was common with them to travel 30, 40, 50, or even 60 miles without encamping. Numbers through theſe hardſhips were obliged to lag in the rear; and of theſe many were left behind, and periſhed; for indeed ſcarce any ever joined the army again. Their miſeries, however, they ſuſtained with incredible patience, being encouraged by the example of their king; who, on this occaſion, ſuffered greater hardſhips than the meaneſt ſoldier in his army. At laſt they-

Macedon.

108 He arrives in Caramania.

they arrived at the capital of Gedrosia, where they refreshed themselves, and staid some time: after which they marched into Caramania; which being a very plentiful country, they there made themselves ample amends for the hardships and fatigues they had sustained. Here they were joined first by Craterus with the troops under his command, with a number of elephants: then came Stasanor president of the Arians, and Pharismanes the son of Phrataphernes governor of Parthia. They brought with them camels, horses, and other beasts of burden, in vast numbers; having foreseen, that the king's march through Gedrosia would be attended with the loss of the greatest part, if not of all the cavalry and beasts belonging to his army.

109 Redresses the grievances of his people.

During Alexander's stay in Caramania, he redressed the injuries of his people, who had been grievously oppressed by their governors during his absence. Here also he was joined by his admiral Nearchus, who brought him an account that all under his command were in perfect safety, and in excellent condition; with which the king was mightily pleased, and, after having bestowed on him singular marks of his favour, sent him back to the navy. Alexander next set out for Persia, where great disorders had been committed during his absence. These also he redressed, and caused the governor to be crucified; appointing in his room Peucestas, who saved his life when he fought singly against a whole garrison as above related. The new governor was no sooner invested with his dignity, than he laid aside the Macedonian garb, and put on that of the Medes; being the only one of Alexander's captains, who, by complying with the manners of the people he governed, gained their affection.

While Alexander visited the different parts of Persia, he took a view, among the rest, of the ruins of Persepolis, where he is said to have expressed great sorrow for the destruction he had formerly occasioned. From Persepolis he marched to Susa, where he gave an extraordinary loose to pleasure; resolving to make himself and his followers some amends for the difficulties they had hitherto undergone: purposing at the same time so effectually to unite his new conquered with his hereditary subjects, that the jealousies and

110 Marries other two wives.

fears which had hitherto tormented both, should no longer subsist. With this view he married two wives of the blood royal of Persia; viz. Barsine, or Statira, the daughter of Darius, and Parysatis the daughter of Ochus. Drypetis, another daughter of Darius, he gave to Hephæstion; Amastrine, the daughter of Oxyartes the brother of Darius, married Craterus; and to the rest of his friends, to the number of 80, he gave other women of the greatest quality. All these marriages were celebrated at once, Alexander himself bestowing fortunes upon them; he directed likewise to take account of the number of his officers and soldiers who had married Asiatic wives; and though they appeared to be 10,000, yet he gratified each of them according to his rank. He next resolved to pay the debts

111 Pays the debts of his army.

of his army, and thereupon issued an edict directing every man to register his name and the sum he owed; with which the soldiers complying slowly, from an apprehension that there was some design against them, Alexander ordered tables heaped with money to be set in all quarters of the camp, and caused every man's debts to be paid on his bare word, without even making any entry of his name: though the whole sum came to 20,000 talents. On such as had distinguished themselves in an extraordinary manner, he bestowed crowns of gold. Peucestas had the first; Leonatus the second; Nearchus the third; Onesicritus the fourth; Hephæstion the fifth; and the rest of his guards had each of them one. After this he made other dispositions for conciliating, as he supposed, the differences among all his subjects. He reviewed the 30,000 youths, whom at his departure for India he had ordered to be taught Greek and the Macedonian discipline; expressing high satisfaction at the fine appearance they made, which rendered them worthy of the appellation he bestowed on them, viz. that of *Epigoni*, i. e. successors. He promoted also, without any distinction of nation, all those who had served him faithfully and valiantly in the Indian war. When all these regulations were made, he gave the command of his heavy armed troops to Hephæstion, and ordered him to march directly to the banks of the Tigris, while in the mean time a fleet was equipped for carrying the king and the troops he retained with him down to the ocean.

Thus ended the exploits of Alexander; the greatest conqueror that ever the world saw, at least with respect to the rapidity of his conquests. In 12 years time he had brought under his subjection Egypt, Libya, Asia Minor, Syria, Phœnicia, Palestine, Babylonia, Persia, with part of India and Tartary. Still, however, he meditated greater things. He had now got a great taste in maritime affairs; and is said to have meditated a voyage to the coasts of Arabia and Ethiopia, and thence round the whole continent of Africa to the straits of Gibraltar. But of this there is no great certainty; though that he intended to subdue the Carthaginians and Italians, is more than probable. All these designs, however, were frustrated by his death, which happened at Babylon in 323 B. C. He is said to have received several warnings of his approaching fate, and to have been advised to avoid that city; which advice he either despised or could not follow. He died of a fever after eight days illness, 112 He dies at Babylon.
without naming any successor; having only given his ring to Perdiccas, and left the kingdom, as he said, *to the most worthy*.

The character of this great prince has been variously 113 His character.
represented; but most historians seem to have looked upon him rather as an illustrious madman than one upon whom the epithet of *Great* could be properly bestowed. From a careful observation of his conduct, however, it must appear, that he possessed not only a capacity to plan, but likewise to execute, the greatest enterprises that ever entered into the mind of any of the human race. From whatever cause the notion originated, it is plain that he imagined himself a divine person, and born to subdue the whole world: and extravagant and impracticable as this scheme may appear at present, it cannot at all be looked upon in the same light in the time of Alexander. The Greeks were in his time the most powerful people in the world in respect to their skill in the military art, and the Persians were the most powerful with respect to wealth and numbers. The only other powerful people in the world were the Carthaginians, Gauls, and Italian nations. From a long series of wars which the Carthaginians

Macedon. ginians carried on in Sicily, it appeared that they were by no means capable of contending with the Greeks, even when they had an immenſe ſuperiority of numbers; much leſs then could they have ſuſtained an attack from the whole power of Greece and Aſia united. The Gauls and Italians were indeed very brave, and of a martial diſpoſition; but they were barbarous, and could not have reſiſted armies well diſciplined and under the command of ſuch a ſkilful leader as Alexander. Even long after this time, it appeared that the Romans themſelves could not have reſiſted the Greeks; ſince Regulus, after having defeated the Carthaginians and reduced them to the utmoſt diſtreſs, was totally unable to reſiſt a Carthaginian army commanded by a Greek general, and guided by Greek diſcipline.

Thus it appears, that the ſcheme of Alexander cannot by any means be accounted that of a madman, or of one who projects great things without judgement or means to execute them. If we conſider from his actions the end which moſt probably he had in view, could his ſcheme have been accompliſhed, we ſhall find it not only the greateſt but the *beſt* that can poſſibly be imagined. He did not conquer to deſtroy, enſlave, or oppreſs; but to civilize and unite the whole world as one nation. No ſooner was a province conquered than he took care of it as if it had been part of his paternal inheritance. He allowed not his ſoldiers to oppreſs and plunder the Perſians, which they were very much inclined to do; on the contrary, by giving into the oriental cuſtoms himſelf, he ſtrove to extinguiſh that inveterate hatred which had ſo long ſubſiſted between the two nations. In the Scythian countries which he ſubdued, he purſued the ſame excellent plan. His courage and military ſkill, in which he never was excelled, were diſplayed, not with a view to rapine or deſultory conqueſt, but to civilize and induce the barbarous inhabitants to employ themſelves in a more proper way of life. "Midſt the hardſhips of a military life (ſays Dr Gillies), obſtinate ſieges, bloody battles, and dear bought victories, he ſtill reſpected the rights of mankind, and practiſed the mild virtues of humanity. The conquered nations enjoyed their ancient laws and privileges; the rigours of deſpotiſm were ſoftened; arts and induſtry encouraged; and the proudeſt Macedonian governors compelled, by the authority and example of Alexander, to obſerve the rules of juſtice towards their meaneſt ſubjects. To bridle the fierce inhabitants of the Scythian plains, he founded cities and eſtabliſhed colonies on the banks of the Iaxartes and Oxus; and thoſe deſtructive campaigns uſually aſcribed to his reſtleſs activity, and blind ambition, appeared to the diſcernment of this extraordinary man not only eſſential to the ſecurity of the conqueſts which he had already made, but neceſſary for the more remote and ſplendid expeditions which he ſtill purpoſed to undertake, and which he performed with ſingular boldneſs and unexampled ſucceſs." In another place, the ſame author gives his character in the following words.

"He was of a low ſtature, and ſomewhat deformed; but the activity and elevation of his mind animated and ennobled his frame. By a life of continual labour, and by an early and habitual practice of the gymnaſtic exerciſes, he had hardened his body againſt the impreſſions of cold and heat, hunger and thirſt, and prepared his robuſt conſtitution for bearing ſuch exertions of ſtrength and activity, as have appeared incredible to the undiſciplined ſoftneſs of modern times. In generoſity and in proweſs, he rivalled the greateſt heroes of antiquity; and in the race of glory, having finally outſtripped all competitors, became ambitious to ſurpaſs himſelf. His ſuperior ſkill in war gave uninterrupted ſucceſs to his arms; and his natural humanity, enlightened by the philoſophy of Greece, taught him to improve his conqueſts to the beſt intereſts of mankind. In his extenſive dominions he built or founded not leſs than 70 cities; the ſituation of which being choſen with conſummate wiſdom, tended to facilitate communication, to promote commerce, and to diffuſe civility through the greateſt nations of the earth. It may be ſuſpected, indeed, that he miſtook the extent of human power, when in the courſe of one reign he undertook to change the face of the world; and that he miſcalculated the ſtubbornneſs of ignorance and the force of habit, when he attempted to enlighten barbariſm, to ſoften ſervitude, and to tranſplant the improvements of Greece into an African and Aſiatic ſoil, where they have never been known to flouriſh. Yet let not the deſigns of Alexander be too haſtily accuſed of extravagance. Whoever ſeriouſly conſiders what he actually performed before his 33d year, will be cautious of determining what he might have accompliſhed had he reached the ordinary term of human life. His reſources were peculiar to himſelf; and ſuch views as well as actions became him as would have become none beſides. In the language of a philoſophical hiſtorian, 'he ſeems to have been given to the world by a peculiar diſpenſation of Providence, being a man like to none other of the human kind.'

"From the part which his father Philip and himſelf acted in the affairs of Greece, his hiſtory has been tranſmitted through the impure channels of exaggerated flattery or malignant envy. The innumerable fictions which diſgrace the works of his biographers, are contradicted by the moſt authentic accounts of his reign, and inconſiſtent with thoſe public tranſactions which concurring authorities confirm. In the preſent work it ſeemed unneceſſary to expatiate on ſuch topics, ſince it is leſs the buſineſs of hiſtory to repeat or even to expoſe errors than to ſelect and impreſs uſeful truths. An author, ambitious of attaining that purpoſe, can ſeldom indulge the language of general panegyric. He will acknowledge, that Alexander's actions were not always blameleſs; but, after the moſt careful examination, he will affirm, that his faults were few in number, and reſulted from his ſituation rather than from his character.

"From the firſt years of his reign he experienced the crimes of diſaffection and treachery, which multiplied and became more dangerous with the extent of his dominions and the difficulty to govern them. Several of his lieutenants early aſpired at independence; others formed conſpiracies againſt the life of their maſter. The firſt criminals were treated with a lenity becoming the generous ſpirit of Alexander: but when Philotas, the ſon of Parmenio, and even Parmenio himſelf, afforded reaſon to ſuſpect their fidelity; when the Macedonian youths, who, according to the inſti-

Macedon.

tution of Philip, guarded the royal pavilion, prepared to murder their fovereign, he found it neceſſary to depart from his lenient fyſtem, and to hold with a firmer hand the reins of government. Elated by unexampled profperity, and the fubmiffive reverence of vanquifhed nations, his loftinefs difgufted the pride of his European troops, particularly the Macedonian nobles, who had been accuftomed to regard themfelves rather as his companions than fubjects. The pretenfions which found policy taught him to form and to maintain, of being treated with thofe external honours ever claimed by the monarchs of the Eaft, highly offended the religious prejudices of the Greeks, who deemed it impious to proftrate the body or bend the knee to any mortal fovereign. Yet had he remitted formalities confecrated by the practice of ages, he muft infenfibly have loft the refpect of his Afiatic fubjects. With a view to reconcile the difcordant principles of the victors and vanquifhed, he affected an immediate defcent from Jupiter Ammon, a claim liberally admitted by the avarice or fears of the Libyan priefts; and which, he had reafon to expect, could not be very obftinately denied by the credulity of the Greeks and Macedonians; who univerfally acknowledged that Philip, his reputed father, was remotely defcended from the Grecian Jupiter. But the fuccefs of this defign, which might have entitled him, as fon of Jupiter, to the fame obeifance from the Greeks which the barbarians readily paid him as monarch of the Eaft, was counteracted, at firft by the fecret difpleafure, and afterwards by the open indignation, of feveral of his generals and courtiers. Nor did the conduct of Alexander tend to extricate him from this difficulty. With his friends he maintained that equal intercourfe of vifits and entertainments which characterized the Macedonian manners; indulged the liberal flow of unguarded converfation; and often exceeded that intemperance in wine which difgraced his age and country."

We fhall conclude this character of Alexander with obferving, that he had in view, and undoubtedly muft have accomplifhed, the fovereignty of the ocean as well as of the land. The violent refiftance made by the Tyrians had fhown him the ftrength of a commercial nation; and it was undoubtedly with a view to enrich his dominions by commerce, that he equipped the fleet on the Indus, and wifhed to keep up a communication with India by fea as well as by land. "It was chiefly with a view to the former of thefe objects (fays Dr Robertfon), that he examined the navigation of the Indus with fo much attention. With the fame view, on his return to Sufa, he in perfon furveyed the courfe of the Euphrates and Tigris, and gave directions to remove the cataracts or dams with which the ancient monarchs of Perfia, induced by a peculiar precept of their religion, which enjoined them to guard with the utmoft care againft defiling any of the elements, had conftructed near the mouths of thefe rivers, in order to fhut out their fubjects from any accefs to the ocean. By opening the navigation in this manner, he propofed, that the valuable commodities of India fhould be conveyed from the Perfian gulf into the interior parts of his Afiatic dominions, while by the Arabian gulf they fhould be carried to Alexandria, and diftributed to the reft of the world.

"Grand and extenfive as thefe fchemes were, the precautions employed, and the arrangements made for carrying them into execution, were fo various and fo proper, that Alexander had good reafon to entertain fanguine hopes of their proving fuccefsful. At the time when the mutinous fpirit of his foldiers obliged him to relinquifh his operations in India, he was not 30 years of age complete. At this enterprifing period of life, a prince of a fpirit fo active, perfevering, and indefatigable, muft have foon found means to refume a favourite meafure on which he had been long intent. If he had invaded India a fecond time, he would not, as formerly, have been obliged to force his way through hoftile and unexplored regions, oppofed at every ftep by nations and tribes of barbarians whofe names had never reached Greece. All Afia, from the fhores of the Ionian fea to the banks of the Hyphafis, would then have been fubject to his dominion; and through that immenfe ftretch of country he had eftablifhed fuch a chain of cities or fortified ftations, that his armies might have continued their march with fafety, and have found a regular fucceffion of magazines provided for their fubfiftence. Nor would it have been difficult for him to bring into the field forces fufficient to have achieved the conqueft of a country fo populous and extenfive as India. Having armed and difciplined his fubjects in the eaft like Europeans, they would have been ambitious to imitate and to equal their inftructors; and Alexander might have drawn recruits, not from his fcanty domains in Macedonia and Greece, but from the vaft regions of Afia, which in every age has covered the earth, and aftonifhed mankind with its numerous armies. When at the head of fuch a formidable power he had reached the confines of India, he might have entered it under circumftances very different from thofe in his firft expedition. He had fecured a firm footing there, partly by means of the garrifons which he left in the three cities which he had built and fortified, and partly by his alliance with Taxiles and Porus. Thefe two Indian princes, won by Alexander's humanity and beneficence, which, as they were virtues feldom difplayed in the ancient mode of carrying on war, excited of courfe a higher degree of admiration and gratitude, had continued fteady in their attachment to the Macedonians. Reinforced by their troops, and guided by their information as well as by the experience which he had acquired in his former campaigns, Alexander muft have made rapid progrefs in a country where every invader from his time to the prefent age has proved fuccefsful.

"But this and all his other fplendid fchemes were terminated at once by his untimely death. In confequence of that, however, events took place which illuftrate and confirm the juftnefs of the preceding fpeculations and conjectures, by evidence the moft ftriking and fatisfactory. When that great empire, which the fuperior genius of Alexander had kept united and in fubjection, no longer felt his fuperintending controul, it broke into pieces, and its various provinces were feized by his principal officers, and parcelled out among them. From ambition, emulation, and perfonal animofity, they foon turned their arms againft one another; and as feveral of the leaders were equally eminent for political abilities and for military fkill, the conteft was maintained long, and carried on with frequent viciffitudes of fortune. Amidft the various convulfions and

3 revolutions

Macedon. revolutions which these occasioned, it was found that the measures of Alexander for the preservation of his conquests had been concerted with such sagacity, that upon the final restoration of tranquillity, the Macedonian dominion continued to be established in every part of Asia, and not one province had shaken off the yoke. Even India, the most remote of Alexander's conquests, quietly submitted to Python the son of Agenor, and afterwards to Seleucus, who successively obtained dominion over that part of Asia. Porus and Taxiles, notwithstanding the death of their benefactor, neither declined submission to the authority of the Macedonians, nor made any attempt to recover independence."

With the death of Alexander fell also the glory of the Macedonians; who very soon relapsed into a situation as bad, or worse, than that in which they had been before the reign of Philip. This was occasioned principally by his not having distinctly named a successor, and having no child of his own come to the years of discretion to whom the kingdom might seem naturally to belong. The ambition and jealousy of his mother Olympias, his queen Roxana, and especially of the great commanders of his army, not only prevented a successor from being ever named, but occasioned the death of every person, whether male or female, who was in the least related to Alexander. To have a just notion of the origin of these disturbances, it is necessary in the first place to understand the situation of the Macedonian affairs at the time of Alexander's death.

114 Causes of the dissolution of his empire.

When Alexander set out for Asia, he left Antipater, as we formerly observed, in Macedon, to prevent any disturbances that might arise either there or in Greece. The Greeks, even during the lifetime of Alexander, bore the superiority which he exercised over them with great impatience; and, though nothing could be more gentle than the government of Antipater, yet he was exceedingly hated, because he obliged them to be quiet. One of the last actions of Alexander's life set all Greece in a flame. He had, by an edict, directed all the cities of Greece to recal their exiles; which edict, when it was published at the Olympic games, created much confusion. Many of the cities were afraid, that, when the exiles returned, they would change the government; most of them doubted their own safety if the edict took place; and all of them held this peremptory decree to be a total abolition of their liberty. No sooner therefore did the news of Alexander's death arrive than they prepared for war.

In Asia the state of things was not much better; not indeed through any inclination of the conquered countries to revolt, but through the dissensions among the commanders.—In the general council which was called soon after the death of Alexander, after much confusion and altercation, it was at last agreed, or rather commanded by the soldiers, that Aridæus the brother of Alexander, who had always accompanied the king, and had been wont to sacrifice with him, should assume the sovereignty.—This Aridæus was a man of very slender parts and judgement, not naturally, but by the wicked practices of Olympias, who had given him poisonous draughts in his infancy, lest he should stand in the way of her son Alexander or any of his family; and for this, or some other reason, Perdiccas, Ptolemy, and most of the horse officers, resented his promotion to such a degree, that they quitted the assembly, and even the city.

115 Aridæus appointed king.

However, Meleager, at the head of the phalanx, vigorously supported their first resolution, and threatened loudly to shed the blood of those who affected to rule over their equals, and to assume a kingdom which noway belonged to them: Aridæus was accordingly arrayed in royal robes, had the arms of Alexander put upon him, and was saluted by the name of *Philip*, to render him more popular. Thus were two parties formed, at the head of whom were Meleager and Perdiccas; both of them pretending vast concern for the public good, yet, at bottom, desiring nothing more than their own advantage. Perdiccas was a man of high birth, and had a supreme command in the army, was much in favour with Alexander, and one in whom the nobility had put great confidence. Meleager had become formidable by having the phalanx on his side, and having the nominal king entirely in his power; for Aridæus, or Philip, was obliged to comply with whatever he thought proper; and publicly declared, that whatever he did was by the advice of Meleager; so that he made his minister accountable for his own schemes, and noway endangered himself. The Macedonians also, besides their regard for the deceased king, soon began to entertain a personal love for Philip on account of his moderation.

116 A party formed by Meleager, and another by Perdiccas.

It is remarkable, however, that notwithstanding all the favours which Alexander had conferred upon his officers, and the fidelity with which they had served him during his life, only two of them were attached to the interests of his family after his death. These were Antipater, and Eumenes the Cardian, whom he had appointed his secretary. Antipater, as we have already seen, was embroiled with the Greeks, and could not assist the royal family who were in Asia; and Eumenes had not as yet sufficient interest to form a party in their favour. In a short time, however, Perdiccas prevailed against Meleager, and got him murdered; by which means the supreme power for a time fell into his hands. His first step, in consequence of this power, was to distribute the provinces of the empire among the commanders in the following manner, in order to prevent competitors, and to satisfy the ambition of the principal commanders of the army. Aridæus, and the son of Roxana, born after the death of his father, were to enjoy the regal authority. Antipater had the government of the European provinces. Craterus had the title of *protector*. Perdiccas was general of the household troops in the room of Hephæstion. Ptolemy the son of Lagus had Egypt, Libya, and that part of Arabia which borders upon Egypt. Cleomenes, a man of infamous character, whom Alexander had made receiver-general in Egypt, was made Ptolemy's deputy. Leomedon had Syria; Philotas, Cilicia; Python, Media; Eumenes, Cappadocia, Paphlagonia, and all the country bordering on the Euxine sea, as far as Trapezus; but these were not yet conquered, so that he was a governor without a province. Antigonus had Pamphylia, Lycia, and Phrygia Major; Cassander, Caria; Menander, Lydia; Leonatus, Phrygia on the Hellespont.

117 Meleager murdered, and the empire divided.

In the mean time, not only Alexander's will, but Alexander himself, was so much neglected, that his body was allowed to remain seven days before any notice was taken of it, or any orders given for its being embalmed. The only will he left was a short memorandum

118 Alexander's body neglected, and his will set aside.

Macedon. randum of ſix things he would have done.—1. The building of a fleet of 1000 ſtout galleys, to be made uſe of againſt the Carthaginians and other nations who ſhould oppoſe the reduction of the ſea-coaſts of Africa and Spain, with all the adjacent iſlands as far as Sicily. 2. A large and regular highway was to be made along the coaſt of Africa, as far as Ceuta and Tangier. 3. Six temples of extraordinary magnificence were to be erected at the expence of 1500 talents each. 4. Caſtles, arſenals, havens, and yards for building ſhips, to be ſettled in proper places throughout his empire. 5. Several new cities were to be built in Europe and Aſia; thoſe in Aſia to be inhabited by colonies from Europe, and thoſe in Europe to be filled with Aſiatics; that, by blending their people and their manners, that hereditary antipathy might be eradicated which had hitherto ſubſiſted between the inhabitants of the different continents. 6. Laſtly, He had projected the building of a pyramid, equal in bulk and beauty to the biggeſt in Egypt, in honour of his father Philip. All theſe deſigns, under pretence of their being expenſive, were referred to a council of Macedonians, to be held nobody knew when or where.

The government, being now in the hands of Perdiccas and Roxana, grew quickly very cruel and diſtaſteful. Alexander was ſcarce dead when the queen ſent for Statira and Drypetis the two daughters of Darius,

119 The daughters of Darius put to death by Roxana.

one of whom had been married to Alexander and the other to Hephæſtion: but as ſoon as they arrived at Babylon, cauſed them both to be murdered, that no ſon of Alexander by any other woman, or of Hephæſtion, might give any trouble to her or her ſon Alexander. Siſygambis, the mother of Darius, no ſooner heard that Alexander the Great was dead, than ſhe laid violent hands on herſelf, being apprehenſive of the calamities which were about to enſue.

120 The Greeks revolt, but are ſubdued.

War was firſt declared in Greece againſt Antipater in the year 321 B. C. Through the treachery of the Theſſalians, that general was defeated, with the army he had under his own command. Leonatus was therefore ſent from Aſia, with a very conſiderable army, to his aſſiſtance; but both were overthrown with great loſs by the confederates, and Leonatus himſelf was killed. In a ſhort time, however, Craterus arrived in Greece with a great army, the command of which he reſigned to Antipater. The army of the confederates amounted to 25,000 foot and 3000 horſe; but Antipater commanded no fewer than 40,000 foot, 3000 archers, and 5000 horſe. In ſuch an unequal conteſt, therefore, the Greeks were defeated, and forced to ſue for peace; which they did not obtain but on condition of their receiving Macedonian garriſons into ſeveral of their cities. At Athens alſo the democratic government was abrogated; and ſuch a dreadful puniſhment did this ſeem to the Athenians, that 22,000 of them left their country, and retired into Macedon.

121 Diſturbances in Aſia and Thrace.

While theſe things were doing in Greece, diſturbances began alſo to ariſe in Aſia and in Thrace. The Greek mercenaries, who were diſperſed through the inland provinces of Aſia, deſpairing of ever being allowed to return home by fair means, determined to attempt it by force. For this purpoſe, they aſſembled to the number of 20,000 foot and 3000 horſe; but were all cut off to a man by the Macedonians. In Thrace, Lyſimachus was attacked by one Seuthes, a prince of that country who claimed the dominions of his anceſtors, and had raiſed an army of 20,000 foot and 8000 horſe. But though the Macedonian commander was forced to engage this army with no more than 4000 foot and 2000 horſe, yet he kept the field of battle, and could not be driven out of the country. Perdiccas, in the mean time, by pretending friendſhip to the royal family, had gained over Eumenes entirely to his intereſt; and at laſt put him in poſſeſſion of the province of Cappadocia by the defeat of Ariarathes king of that country, whom he afterwards cruelly cauſed to be crucified. His ambition, however, now began to lead him into difficulties. At the firſt diviſion of the provinces, Perdiccas, to ſtrengthen his own authority, had propoſed to marry Nicæa the daughter of Antipater; and ſo well was this propoſal reliſhed, that her brethren Jollas and Archias conducted her to him, in order to be preſent at the celebration of the nuptials. But Perdiccas now had other things in view. He had been ſolicited by Olympias to marry her daughter Cleopatra, the widow of Alexander king of Epirus, and who then reſided at Sardis in Lydia. Eumenes promoted this match to the utmoſt of his power, becauſe he thought it would be for the intereſt of the royal family; and his perſuaſions had ſuch an effect on Perdiccas, that he was ſent to Sardis to compliment Cleopatra, and to carry preſents to her in name of her new lover. In the abſence of Eumenes, however, Alcetas, the brother of Perdiccas, perſuaded him to marry Nicæa; but, in order to gratify his ambition, he reſolved to divorce her immediately after marriage, and marry Cleopatra. By this laſt marriage, he hoped to have a pretence for altering the government of Macedon: and, as a neceſſary meaſure preparative to theſe, he entered into contrivances for deſtroying Antigonus. Unfortunately for himſelf, however, he ruined all his ſchemes by his own jealouſy and precipitate cruelty. Cynane, the daughter of Philip by his ſecond wife, had brought her daughter named *Adda*, and who was afterwards named *Eurydice*, to court, in hopes that King Aridæus might marry her. Againſt Cynane, Perdiccas, from ſome political motives, conceived ſuch a grudge, that he cauſed her to be murdered. This raiſed a commotion in the army; which frightened Perdiccas to ſuch a degree, that he now promoted the match between Aridæus and Eurydice; to prevent which, he had murdered the mother of the young princeſs. But, in the mean time, Antigonus, knowing the deſigns of Perdiccas againſt himſelf, fled with his ſon Demetrius to Greece, there to take ſhelter under the protection of Antipater and Craterus, whom he informed of the ambition and cruelty of the regent.

122 Ambition and cruelty of Perdiccas.

123 A combination againſt him.

A civil war was now kindled. Antipater, Craterus, Neoptolemus, and Antigonus, were combined againſt Perdiccas; and it was the misfortune of the empire in general, that Eumenes, the moſt able general, as well as the moſt virtuous of all the commanders, was on the ſide of Perdiccas, becauſe he believed him to be in the intereſt of Alexander's family. Ptolemy, in the mean time, remained in quiet poſſeſſion of Egypt; but without the leaſt intention of owning any perſon for his ſuperior: however, he alſo acceded to the league formed againſt Perdiccas; and thus the only perſon in the whole empire who conſulted the intereſt of the royal family was Eumenes.

It

124 Alexander buried in Egypt.

It was now thought proper to bury the body of Alexander, which had been kept for two years, during all which time preparations had been making for it. Aridæus, to whoſe care it was committed, ſet out from Babylon for Damaſcus, in order to carry the king's body to Egypt. This was ſore againſt the will of Perdiccas; for it ſeems there was a ſuperſtitious report, that wherever the body of Alexander was laid, that country ſhould flouriſh moſt. Perdiccas, therefore, out of regard to his native ſoil, would have it conveyed to the royal ſepulchres in Macedon; but Aridæus, pleading the late king's expreſs direction, was determined to carry it into Egypt, from thence to be conveyed to the temple of Jupiter Ammon.—The funeral was accordingly conducted with all imaginable magnificence. Ptolemy came to meet the body as far as Syria: but, inſtead of burying it in the temple of Jupiter Ammon, erected a ſtately temple for it in the city of Alexandria; and, by the reſpect he ſhowed for his dead maſter, induced many of the Macedonian veterans to join him, and who were afterwards of the greateſt ſervice to him.

125 Perdiccas killed by his own men.

No ſooner was the funeral over, than both the parties above mentioned fell to blows. Perdiccas marched againſt Ptolemy: but was ſlain by his own men, who, after the death of their general, ſubmitted to his antagoniſt; and thus Eumenes was left alone to contend againſt all the other generals who had ſerved under Alexander. In this conteſt, however, he would by no means have been overmatched, had his ſoldiers been attached to him; but as they had been accuſtomed to ſerve under thoſe very generals againſt whom they were now to fight, they were on all occaſions ready to betray and deſert Eumenes. However, he defeated and killed Neoptolemus and Craterus, but then found himſelf obliged to contend with Antipater and Antigonus. Antipater was now appointed protector of the kings, with ſovereign power; and

126 A new diviſion of the empire.

Eumenes was declared a public enemy. A new diviſion of Alexander's empire took place. Egypt, Libya, and the parts adjacent, were given to Ptolemy, becauſe they could not be taken from him. Syria was confirmed to Leomedon. Philoxenus had Cilicia. Meſopotamia and Arbelitus were given to Amphimachus. Babylon was beſtowed on Seleucus. Suſiana fell to Antigenes, who commanded the Macedonian *Argyraſpidæ* or *Silver Shields*, becauſe he was the firſt who oppoſed Perdiccas. Peuceſtas held Perſia. Tlepolemus had Caramania. Python had Media as far as the Caſpian ſtraits. Staſander had Aria and Drangia; Philip, Parthia; Staſonor, Bactria and Sogdia; Sybirtius, Aracopa; Oxyartes, the father of Roxana, Parapomiſis. Another Python had the country between this province and India. Porus and Taxiles held what Alexander had given them, becauſe they would not part with any of their dominions. Cappadocia was aſſigned to Nicanor. Phrygia Major, Lycaonia, Pamphylia, and Lycia, were given to Antigonus; Caria to Caſſander, Lydia to Clytus, Phrygia the Leſs to Aridæus. Caſſander was appointed general of the horſe; while the command of the houſehold troops was given to Antigonus, with orders to proſecute the war againſt Eumenes. Antipater having thus ſettled every thing as well as he could, returned to Macedon with the two kings, to the great joy of his countrymen, having left his ſon Caſſander to be a check upon Antigonus in Aſia.

Matters now ſeemed to wear a better aſpect than they had yet done; and, had Eumenes believed that his enemies really conſulted the intereſt of Alexander's family, there is not the leaſt doubt that the war would have been immediately terminated. He ſaw, however, that the deſign of Antigonus was only to ſet up for himſelf, and therefore he refuſed to ſubmit. From this time, therefore, the Macedonian empire ceaſed in Aſia: and an account of the tranſactions of this part of the world fall to be recorded under the article SYRIA. The Macedonian affairs are now entirely confined to the kingdom of Macedon itſelf, and to Greece.

127 Total deſtruction of Alexander's family.

Antipater had not long been returned to Macedon, when he died; and the laſt action of his life completed the ruin of Alexander's family. Out of a view to the public good, he had appointed Polyſperchon, the eldeſt of Alexander's captains at hand, to be *protector* and *governor* of Macedon. This failed not to diſguſt his ſon Caſſander; who thought he had a natural right to theſe offices, and of courſe kindled a new civil war in Macedon. This was indeed highly promoted by his firſt actions as a governor. He began with attempting to remove all the governors appointed in Greece by Antipater, and to reſtore democracy wherever it had been aboliſhed. The immediate conſequence of this was, that the people refuſed to obey their magiſtrates; the governors refuſed to reſign their places, and applied for aſſiſtance to Caſſander. Polyſperchon alſo had the imprudence to recal Olympias from Epirus, and allow her a ſhare in the adminiſtration; which Antipater, and even Alexander himſelf, had always refuſed her. The conſequence of all this was, that Caſſander invaded Greece, where he prevailed againſt Polyſperchon: Olympias returned to Macedon, where ſhe cruelly murdered Aridæus and his wife Eurydice; ſhe herſelf was put to death by Caſſander, who afterwards cauſed Roxana and her ſon to be murdered, and Polyſperchon being driven into Etolia, firſt raiſed to the crown Hercules the ſon of Alexander by the daughter of Darius, and then by the inſtigation of Caſſander murdered him, by which means the line of Alexander the Great became totally extinct.

128 Various revolutions in the government.

Caſſander having thus deſtroyed all the royal family, aſſumed the regal title, as he had for 16 years before had all the power. He enjoyed the title of *king of Macedon* only three years; after which he died, about 298 B. C. By Theſſalonica, the daughter of Philip king of Macedon, he left three ſons, Philip, Antipater, and Alexander. Philip ſucceeded him, but ſoon after died of a conſumption. A conteſt immediately began between the two brothers, Antipater and Alexander. Antipater ſeized the kingdom; and to ſecure himſelf in it, murdered his mother Theſſalonica, if not with his own hand, at leaſt the execrable act was committed in his preſence. Alexander invited Pyrrhus king of Epirus, and Demetrius the ſon of Antigonus, to aſſiſt him and revenge the death of his mother. But Pyrrhus being bought off, and a peace concluded between the brothers, Alexander, being afraid of having too many protectors, formed a ſcheme of getting Demetrius aſſaſſinated. Inſtead of this, however, both he and Antipater were put to death; and

Macedon. Demetrius became king of Macedon four years after the death of Cassander.

In 287 B. C. Demetrius was driven out by Pyrrhus, who was again driven out by Lysimachus two years after, who was soon after killed by Seleucus Nicanor; and Seleucus, in his turn, was murdered by Ptolemy Ceraunus, who became king of Macedon about 280 B. C. The new king was in a short time cut off, with his whole army, by the Gauls; and Antigonus Gonatus, the son of Demetrius Poliorcetes, became king of Macedon in 278 B. C. He proved successful against the Gauls, but was driven out by Pyrrhus king of Epirus; who, however, soon disobliged his subjects to such a degree, that Antigonus recovered a great part of his kingdom. But in a little time, Pyrrhus being killed at the siege of Argos in Greece, Antigonus was restored to the whole of Macedon; but scarcely was he seated on the throne, when he was driven from it by Alexander the son of Pyrrhus. This new invader was, in his turn, expelled by Demetrius the son of Antigonus; who, though at that time but a boy, had almost made himself master of Epirus. In this enterprise, however, he was disappointed; but by his means Antigonus was restored to his kingdom, which he governed for many years in peace. By a stratagem he made himself master of the city of Corinth, and from that time began to form schemes for the thorough conquest of Greece. The method he took to accomplish this was, to support the petty tyrants of Greece against the free states: which indeed weakened the power of the latter; but involved the whole country in so many calamities, that these transactions could not redound much to the reputation either of his arms or his honour. About 243 B. C. he died, leaving the kingdom to his son, Demetrius II.

129 War with the Romans.

Neither Demetrius, nor his successor Antigonus Doson, performed any thing remarkable. In 221 B. C. the kingdom fell to Philip, the last but one of the Macedonian monarchs. To him Hannibal applied for assistance after the battle of Cannæ, which he refused; and the same imprudence which made him refuse this assistance prompted him to embroil himself with the Romans; and at last to conclude a treaty with them, by which he in effect became their subject, being tied up from making peace or war but according to their pleasure. In 179 B. C. he was succeeded by his eldest son Perseus, under whom the war with the Romans was renewed. Even yet the Macedonians were terrible in war; and their phalanx, when properly conducted, seems to have been absolutely invincible by any method of making war known at that time. It consisted of 16,000 men, of whom 1000 marched abreast, and thus was 16 men deep, each of whom carried a kind of pike 23 feet long. The soldiers stood so close, that the pikes of the fifth rank reached their points beyond the front of the battle. The hindermost ranks leaned their pikes on the shoulders of those who went before them, and, locking them fast, pressed briskly against them when they made the charge; so that the first five ranks had the impetus of the whole phalanx, which was the reason why the shock was generally irresistible. The Romans had never encountered such a terrible enemy; and in the first battle, which happened 171 B. C. they were defeated with the loss of 2200 men, while the Macedonians lost no more than 60. The generals of Perseus now pressed him to storm the enemy's camp: but he being naturally of a cowardly disposition, refused to comply, and thus the best opportunity he ever had was lost. Still, however, the Romans gained little or no advantage, till the year 168 B. C. when Paulus Æmilius, a most experienced commander, was sent to Macedon. Perseus now put all upon the issue of a general engagement; and Æmilius, with all his courage and military experience, would have been defeated, had the Macedonians been commanded by a general of the smallest courage or conduct. The light-armed Macedonians charged with such vigour, that after the battle, some of their bodies were found within two furlongs of the Roman camp. When the phalanx came to charge, the points of their spears striking into the Roman shields, kept the heavy-armed troops from making any motion; while, on the other hand, Perseus's light-armed men did terrible execution. On this occasion, it is said, that Æmilius tore his clothes, and gave up all hopes However, perceiving that as the phalanx gained ground it lost its order in several places, he caused his own light-armed troops to charge in those places, whereby the Macedonians were soon put into confusion. If Perseus with his horse had on the first appearance of this charged the Romans briskly, his infantry would have been able to recover themselves; but instead of this, he betook himself to flight, and the infantry at last did the same, but not till 20,000 of them had lost their lives.

Macedon ‖ Macer.

This battle decided the fate of Macedon, which immediately submitted to the conqueror. The cowardly king took refuge in the island of Samothrace: but was at last obliged to surrender to the Roman consul, by whom he was carried to Rome, led in triumph, and afterwards most barbarously used. Some pretenders to the throne appeared afterwards; but being unable to defend themselves against the Romans, the country was reduced to a Roman province in 148 B. C. To them it continued subject till the year 1357, when it was reduced by the Turkish sultan Bajazet, and has remained in the hands of the Turks ever since.

130 Macedonia becomes a Roman province.

MACEDONIANS, in ecclesiastical history, the followers of Macedonius, bishop of Constantinople, who through the influence of the Eunomians, was deposed by the council of Constantinople in 360, and sent into exile. He considered the Holy Ghost as a divine energy diffused throughout the universe, and not as a person distinct from the Father and the Son. The sect of Macedonians was crushed before it had arrived at its full maturity, by the council assembled by Theodosius in 381, at Constantinople. See SEMI-ARIANS.

MACEDONIUS. See MACEDONIANS.

MACER, EMILIUS, an ancient Latin poet, was born at Verona, and flourished under Augustus Cæsar. Eusebius relates, that he died a few years after Virgil. Ovid speaks of a poem of his, on the nature and quality of birds, serpents, and herbs; which he says Macer being then very old had often read to him:

Sæpe suas volucres legit mihi grandior ævo,
Quæque nocet serpens, quæ juvat herba, Macer.
De Ponto, lib. iv. eleg. 10.

There is extant a poem upon the nature and power of herbs under Macer's name; but it is spurious. He also wrote

wrote a ſupplement to Homer, as Quintus Calaber did afterwards in Greek :

Tu canis æterno quicquid reſtabat Homero :
Ne careant ſumma Troica bella manu.
De Ponto, lib. ii. eleg. 10.

MACERATION, is an infuſion of, or ſoaking ingredients in water or any other fluid, in order either to ſoften them or draw out their virtues.

MACERATA, a handſome and populous town of Italy, in the territory of the church, and in the Marche of Ancona, with a biſhop's ſee, and an univerſity. It is ſeated near the mountain Chiento, in E. Long. 13. 37. N. Lat. 43. 15.

MACHAON, a celebrated phyſician among the ancients, ſon of Æſculapius and brother to Podalirius. He went to the Trojan war with the inhabitants of Trica, Ithome, and Œchalia. According to ſome, he was king of Meſſenia. He was phyſician to the Greeks, and healed the wounds which they received during the Trojan war. Some ſuppoſe he was killed before Troy by Eurypylus the ſon of Telephus. He received divine honours after death, and had a temple in Meſſenia.

MACHÆRUS, in *Ancient Geography*, a citadel on the other ſide Jordan, near the mountains of Moab, not far from and to the north of the *Lacus Aſphaltites*. It was the ſouth boundary of the Peræa: ſituated on a mountain encompaſſed round with deep and broad valleys; built by Alexander king of the Jews; deſtroyed by Gabinius, in the war with Ariſtobulus, and rebuilt by Herod, with a cognominal town round it. Here John the Baptiſt was beheaded (Joſephus).

MACHIAN, one of the Molucca iſlands, in the Eaſt Indian ocean, about 20 miles in circumference, and the moſt fertile of them all. It likewiſe produces the beſt cloves; and is in poſſeſſion of the Dutch, who have three ſtrong forts built on it.

MACHIAVEL, Nicholas, a famous political writer of the 16th century, was born of a diſtinguiſhed family at Florence. He wrote in his native language with great elegance and politeneſs, though he underſtood very little of the Latin tongue; but he was in the ſervice of Marcellus Virgilius, a learned man, who pointed out to him many of the beautiful paſſages in the ancients, which Machiavel had the art of placing properly in his works. He compoſed a comedy upon the ancient Greek model: in which he turned into ridicule many of the Florentine ladies, and which was ſo well received, that Pope Leo X. cauſed it to be acted at Rome. Machiavel was ſecretary, and afterwards hiſtoriographer, to the republic of Florence. The houſe of Medicis procured him this laſt office, together with a handſome ſalary, in order to pacify his reſentment for having ſuffered the torture upon ſuſpicion of being an accomplice in the conſpiracy of the Soderini againſt that houſe, when Machiavel bore his ſufferings without making any confeſſion. The great encomiums he beſtowed upon Brutus and Caſſius, both in his converſations and writings, made him ſtrongly ſuſpected of being concerned in another conſpiracy againſt Cardinal Julian de Medicis, who was afterwards pope under the name of *Clement VII.* However, they carried on no proceedings againſt him; but from that time he turned every thing into ridicule, and gave himſelf up to irreligion. He died in 1530, of a remedy which he had taken by way of prevention. Of all his writings, that which has made the moſt noiſe, and has drawn upon him the moſt enemies, is a political treatiſe entitled the *Prince*; which has been tranſlated into ſeveral languages, and wrote againſt by many authors. The world is not agreed as to the motives of this work; ſome thinking he meant to recommend tyrannical maxims; others, that he only delineated them to excite abhorrence. Machiavel alſo wrote, Reflections on Titus Livius, which are extremely curious; The Hiſtory of Florence, from the year 1205 to 1494; and a quarto volume of Poems and other pieces. Mr Harrington conſiders him as a ſuperior genius, and as the moſt excellent writer on politics and government that ever appeared.

MACHINE, (*Machina*), in the general, ſignifies any thing that ſerves to augment or to regulate moving powers: Or it is any body deſtined to produce motion, ſo as to ſave either time or force. The word comes from the Greek μαχανη, "machine, invention, art:" And hence, in ſtrictneſs, a machine is ſomething that conſiſts more in art and invention, than in the ſtrength and ſolidity of the materials; for which reaſon it is that inventors of machines are called *ingenieurs* or *engineers*.

Machines are either ſimple or compound. The ſimple ones are the ſeven mechanical powers, viz. lever, balance, pulley, axis and wheel, wedge, ſcrew, and inclined plane. See Mechanics.

From theſe the compound ones are formed by various combinations, and ſerve for different purpoſes. See Mechanics; alſo Agriculture, Cannon, Centrifugal, Steam, Furnace, Burroughs, Ramsden, &c. &c.

Machines uſed in war amongſt the Greeks were principally theſe; 1. Κλιμακες, or ſcaling ladders; 2. The battering ram; 3. The *helepolis*; 4. The χελωνη or tortoiſe, called by the Romans *teſtudo*; 5. The σχωμα or *agger*, which was faced with ſtone, and raiſed higher than the wall: 6. Upon the σχωμα were built πυργοι or towers of wood; 7. Γερραι, or oſier hurdles; 8. *Catapultæ*, or καταπελται, from which they threw arrows with amazing force; and, 9. The λιθοβολοι, πετροβολοι, or αφετηρια, from which ſtones were caſt with great velocity.

The principal warlike machines made uſe of by the Romans were, the ram, the *lupus* or wolf, the *teſtudo* or tortoiſe, the *baliſta*, the *catapulta*, and the *ſcorpion*.

MACHINERY, in epic and dramatic poetry, is when the poet introduces the uſe of machines; or brings ſome ſupernatural being upon the ſtage, in order to ſolve ſome difficulty or to perform ſome exploit out of the reach of human power.

The ancient dramatic poets never made uſe of machines, unleſs where there was an abſolute neceſſity for ſo doing; whence the precept of Horace,

Nec Deus interſit, niſi dignus vindice nodus
Inciderit.

It is quite otherwiſe with epic poets, who introduce machines in every part of their poems; ſo that nothing is done without the intervention of the gods. In Milton's Paradiſe Loſt, by far the greater part of the actors

Machul || Mackenzie.

tors are ſupernatural perſonages: Homer and Virgil do nothing without them; and, in Voltaire's Henriade, the poet has made excellent uſe of St Louis.

As to the manner in which theſe machines ſhould act, it is ſometimes inviſibly, by ſimple inſpirations and ſuggeſtions; ſometimes by actually appearing under ſome human form; and, laſtly, by means of dreams and oracles, which partake of the other two. However, all theſe ſhould be managed in ſuch a manner as to keep within the bounds of probability.

Plate CCXCVIII.

MACHUL, an inſtrument of muſic among the Hebrews. Kircher apprehends that the name was given to two kinds of inſtruments, one of the ſtringed and the other of the pulſatile kind. That of the former ſort had ſix chords; though there is great reaſon to doubt whether an inſtrument requiring the aid of the hair-bow, and ſo much reſembling the violin, be ſo ancient. The ſecond kind was of a circular form, made of metal, and either hung round with little bells, or furniſhed with iron rings ſuſpended on a rod or bar that paſſed acroſs the circle. Kircher ſuppoſes that it was moved to and fro by a handle fixed to it, and thus emitted a melancholy kind of murmur.

MACHYNLETH, a town of Montgomeryſhire in North Wales, 198 miles from London, and 32 from Montgomery. It is an ancient town; and has a market on Mondays, and fairs on May 16, June 26, July 9, September 18, and November 25, for ſheep, horned cattle, and horſes. It is ſeated on the river Douay, over which there is a large ſtone bridge, which leads into Merionethſhire. It was here that Owen Glyndwr exerciſed the firſt acts of his royalty in 1402. Here he accepted the crown of Wales, and aſſembled a parliament; and the houſe wherein they met is now ſtanding, divided into tenements.

MACKENZIE, Sir George, an able lawyer, a polite ſcholar, and a celebrated wit, was born at Dundee in the county of Angus in Scotland in 1636, and ſtudied at the univerſities of Aberdeen and St Andrew's; after which he applied himſelf to the civil law, travelled into France, and proſecuted his ſtudy in that faculty for about three years. At his return to his native country he became an advocate in the city of Edinburgh; and ſoon gained the character of an eminent pleader. He did not, however, ſuffer his abilities to be confined entirely to that province. He had a good taſte for polite literature; and he gave the public, from time to time, inconteſtable proofs of an uncommon proficiency therein. He had practiſed but a few years, when he was promoted to the office of a judge in the criminal court; and, in 1674, was made king's advocate, and one of the lords of the privy council in Scotland. He was alſo knighted by his majeſty. In theſe ſtations he met with a great deal of trouble, on account of the rebellions which happened in his time; and his office of advocate requiring him to act with ſeverity, he did not eſcape being cenſured, as if in the deaths of ſome particular perſons who were executed he had ſtretched the laws too far. But there does not ſeem to have been any juſt foundation for this clamour againſt him; and it is generally agreed, that he acquitted himſelf like an able and upright magiſtrate. Upon the abrogation of the penal laws by King James II. our advocate, though he had always been remarkable for his loyalty, and even cenſured for his zeal againſt traitors and fanatics, thought himſelf obliged to reſign his poſt; being convinced, that he could not diſcharge the duties of it in that point with a good conſcience. But he was ſoon after reſtored, and held his offices till the Revolution; an event which, it ſeems, he could not bring himſelf to approve. He had hoped that the prince of Orange would have returned to his own country when matters were adjuſted between the king and his ſubjects; and upon its proving otherwiſe, he quitted all his employments in Scotland, and retired into England, reſolving to ſpend the remainder of his days in the univerſity of Oxford. He arrived there in September 1689, and proſecuted his ſtudies in the Bodleian library, being admitted a ſtudent there by a grace paſſed in the congregation, June 2. 1690. In the ſpring following, he went to London; where he fell into a diſorder, of which he died in May 1691. His corpſe was conveyed by land to Scotland, and interred there with great pomp and ſolemnity. "The politeneſs of his learning, and the ſprightlineſs of his wit, were (ſays the reverend Mr Granger) conſpicuous in all his pleadings, and ſhone in his ordinary converſation." Mr Dryden acknowledges, that he was unacquainted with what he calls the *beautiful turn of words and thoughts in poetry*, till they were explained and exemplified to him in a converſation with that noble wit of Scotland Sir George Mackenzie.—He wrote ſeveral pieces of hiſtory and antiquities; Inſtitutions of the laws of Scotland; Eſſays upon various ſubjects, &c. His works were printed together at Edinburgh in 1716, in 2 vols. folio.

Mackerel, Maclaurin.

MACKEREL. See Scomber, Ichthyology *Index*.

MACLAURIN, Colin, a moſt eminent mathematician and philoſopher, was the ſon of a clergyman, and born at Kilmoddan in Scotland in 1698. He was ſent to the univerſity of Glaſgow in 1709; where he continued five years, and applied himſelf to ſtudy in a moſt intenſe manner. His great genius for mathematical learning diſcovered itſelf ſo early as at twelve years of age; when, having accidentally met with an Euclid in a friend's chamber, he became in a few days maſter of the firſt ſix books without any aſſiſtance: and it is certain, that in his 16th year he had invented many of the propoſitions which were afterwards publiſhed under the title of *Geometria Organica*. In his 15th year he took the degree of maſter of arts; on which occaſion he compoſed and publicly defended a theſis On the power of Gravity, with great applauſe. After this he quitted the univerſity, and retired to a country-ſeat of his uncle, who had the care of his education; for his parents had been dead ſome time. Here he ſpent two or three years in purſuing his favourite ſtudies; but, in 1717, he offered himſelf a candidate for the profeſſorſhip of mathematics in the Mariſchal college of Aberdeen, and obtained it after a ten days trial with a very able competitor. In 1719, he went to London, where he became acquainted with Dr Hoadly then biſhop of Bangor, Dr Clarke, Sir Iſaac Newton, and other eminent men; at which time alſo he was admitted a member of the Royal Society; and in another journey in 1721, he contracted an intimacy with Martin Folkes, Eſq. the preſident of it, which laſted to his death.

In 1722, Lord Polwarth, plenipotentiary of the king of Great Britain at the congreſs of Cambray, engaged him

Maclaurin. him to go as a tutor and companion to his eldeſt ſon, who was then to ſet out on his travels. After a ſhort ſtay at Paris, and viſiting other towns in France, they fixed in Lorrain; where Maclaurin wrote his piece On the Percuſſion of Bodies, which gained the prize of the Royal Academy of Sciences for the year 1724. But his pupil dying ſoon after at Montpelier, he returned immediately to his profeſſion at Aberdeen. He was hardly ſettled here, when he received an invitation to Edinburgh; the curators of that univerſity being deſirous that he ſhould ſupply the place of Mr James Gregory, whoſe great age and infirmities had rendered him incapable of teaching. He had ſome difficulties to encounter, ariſing from competitors, who had good intereſt with the patrons of the univerſity, and alſo from the want of an additional fund for the new profeſſor; which however at length were all ſurmounted, principally by the means of Sir Iſaac Newton. In November 1725, he was introduced into the univerſity. After this, the mathematical claſſes ſoon became very numerous, there being generally upwards of 100 young gentlemen attending his lectures every year; who being of different ſtandings and proficiency, he was obliged to divide them into four or five claſſes, in each of which he employed a full hour every day, from the firſt of November to the firſt of June.

He lived a bachelor to the year 1733: but being not leſs formed for ſociety than for contemplation, he then married Anne, the daughter of Mr Walter Stewart ſolicitor-general to his late majeſty for Scotland. By this lady he had ſeven children, of whom two ſons and three daughters, together with his wife, ſurvived him. In 1734, Berkeley, biſhop of Cloyne, publiſhed a piece called "The Analyſt;" in which he took occaſion, from ſome diſputes that had ariſen concerning the grounds of the fluxionary method, to explode the method itſelf, and alſo to charge mathematicians in general with infidelity in religion. Maclaurin thought himſelf included in this charge, and began an anſwer to Berkeley's book: but, as he proceeded, ſo many diſcoveries, ſo many new theories and problems occurred to him, that inſtead of a vindicatory pamphlet, his work came out, A complete ſyſtem of fluxions, with their application to the moſt conſiderable problems in geometry and natural philoſophy. This work was publiſhed at Edinburgh in 1742, 2 vols. 4to; and as it coſt him infinite pains, ſo it is the moſt conſiderable of all his works, and will do him immortal honour. In the mean time, he was continually obliging the public with ſome performance or obſervation of his own; many of which were publiſhed in the fifth and ſixth volumes of the "Medical Eſſays" at Edinburgh. Some of them were likewiſe publiſhed in the Philoſophical Tranſactions; as the following: 1. Of the conſtruction and meaſure of curves, N° 356. 2. A new method of deſcribing all kinds of curves, N° 359. 3. A letter to Martin Folkes, Eſq. on equations with impoſſible roots, May 1726, N° 394. 4. Continuation of the ſame, March 1729, N° 408. 5. December the 21ſt, 1732, on the deſcription of curves; with an account of farther improvements, and a paper dated at Nancy, November 27, 1722, N° 439. 6. An account of the treatiſe of fluxions, January 27, 1742, N° 467. 7. The ſame continued, March 10. 1742, N° 469. 8. A rule for finding the meridional parts of a ſpheroid with the ſame exactneſs as of a ſphere, Auguſt 1741, N° 461. 9. Of the baſis of the cells wherein the bees depoſite their honey; Nov. 3. 1734, N° 471. Maclaurin.

In the midſt of theſe ſtudies, he was always ready to lend his aſſiſtance in contriving and promoting any ſcheme which might contribute to the ſervice of his country. When the earl of Morton ſet out in 1739 for Orkney and Shetland, to viſit his eſtates there, he deſired Mr Maclaurin to aſſiſt him in ſettling the geography of thoſe countries, which is very erroneous in all our maps; to examine their natural hiſtory, to ſurvey the coaſts, and to take the meaſure of a degree of the meridian. Maclaurin's family affairs, and other connexions, would not permit him to do this; he drew, however, a memorial of what he thought neceſſary to be obſerved, furniſhed the proper inſtruments, and recommended Mr Short, the famous optician, as a fit operator for the management of them. He had ſtill another ſcheme for the improvement of geography and navigation, of a more extenſive nature; which was the opening a paſſage from Greenland to the South ſea by the north pole. That ſuch a paſſage might be found, he was ſo fully perſuaded, that he has been heard to ſay, if his ſituation could admit of ſuch adventures, he would undertake the voyage, even at his own charge. But when ſchemes for finding it were laid before the parliament in 1744, and himſelf conſulted by ſeveral perſons of high rank concerning them, before he could finiſh the memorials he propoſed to ſend, the premium was limited to the diſcovery of a north-weſt paſſage: and he uſed to regret, that the word weſt was inſerted, becauſe he thought that paſſage, if at all to be found, muſt lie not far from the pole.

In 1745, having been very active in fortifying the city of Edinburgh againſt the rebel army, he was obliged to fly from thence to the north of England; where he was invited by Herring, then archbiſhop of York, to reſide with him during his ſtay in this country. In this expedition, however, being expoſed to cold and hardſhips, and naturally of a weak and tender conſtitution, he laid the foundation of an illneſs which put an end to his life, in June 1746, at the age of 48.

Mr Maclaurin was a very good as well as a very great man, and worthy of love as well as admiration. His peculiar merit as a philoſopher was, that all his ſtudies were accommodated to general utility; and we find, in many places of his works, an application even of the moſt abſtruſe theories, to the perfecting of mechanical arts. He had reſolved, for the ſame purpoſe, to compoſe a courſe of practical mathematics, and to reſcue ſeveral uſeful branches of the ſcience from the bad treatment they often met with in leſs ſkilful hands. But all this his death prevented; unleſs we ſhould reckon, as a part of his intended work, the tranſlation of Dr David Gregory's "Practical Geometry," which he reviſed, and publiſhed with additions, 1745. In his lifetime, however, he had frequent opportunities of ſerving his friends and his country by his great ſkill. Whatever difficulty occurred concerning the conſtructing or perfecting of machines, the working of mines, the improving of manufactures, the conveying of water, or the execution of any other public work, he

Maclaurin.

he was at hand to resolve it. He was likewise employed to terminate some disputes of consequence that had arisen at Glasgow concerning the gauging of vessels; and for that purpose presented to the commissioners of excise two elaborate memorials, with their demonstrations, containing rules for which the officers now act. He made also calculations relating to the provision, now established by law, for the children and widows of the Scots clergy, and of the professors in the universities, entitling them to certain annuities and sums, upon the voluntary annual payment of a certain sum by the incumbent. In contriving and adjusting this wise and useful scheme, he bestowed a great deal of labour, and contributed not a little towards bringing it to perfection. It may be said of such a man, that "he lived to some purpose;" which can hardly be said of those, how uncommon soever their abilities and attainments, who spend their whole time in abstract speculations, and produce nothing to the real use and service of their fellow creatures.

Of his works, we have mentioned his *Geometria Organica*, in which he treats of the description of curve lines by continued motion. We need not repeat what has been said concerning his piece which gained the prize of the Royal Academy of Sciences in 1724. In 1740, the academy adjudged him a prize, which did him still more honour, for solving the motion of the tides from the theory of gravity; a question which had been given out the former year, without receiving any solution. He had only ten days to draw this paper up in, and could not find leisure to transcribe a fair copy; so that the Paris edition of it is incorrect. He afterwards revised the whole, and inserted it in his Treatise of Fluxions; as he did also the substance of the former piece. These, with the Treatise of Fluxions, and the pieces printed in the Philosophical Transactions, of which we have given a list, are all the writings which our author lived to publish. Since his death, two volumes more have appeared; his Algebra, and his Account of Sir Isaac Newton's Philosophical Discoveries. His Algebra, though not finished by himself, is yet allowed to be excellent in its kind; containing, in no large volume, a complete elementary treatise of that science, as far as it has hitherto been carried. His Account of Sir Isaac Newton's Philosophy was occasioned in the following manner: Sir Isaac dying in the beginning of 1728, his nephew, Mr Conduitt, proposed to publish an account of his life, and desired Mr Maclaurin's assistance. The latter, out of gratitude to his great benefactor, cheerfully undertook, and soon finished, the history of the progress which philosophy had made before Sir Isaac's time, and this was the first draught of the work in hand; which not going forward, on account of Mr Conduitt's death, was returned to Mr Maclaurin.—To this he afterwards made great additions, and left it in the state in which it now appears. His main design seems to have been, to explain only those parts of Sir Isaac's philosophy which have been, and still are, controverted: and this is supposed to be the reason why his grand discoveries concerning light and colours are but transiently and generally touched upon. For it is known, that ever since the experiments, on which his doctrine of light and colours is founded, have been repeated with due care, this doctrine has not been contested; whereas his accounting for the celestial motions, and the other great appearances of nature, from gravity, is misunderstood, and even ridiculed by some to this day.

Macquer.

MACQUER, Philippe, advocate of the parliament of Paris, where he was born in 1720, being descended from a respectable family. A weakness in his lungs having prevented him from engaging in the laborious exercises of pleading, he dedicated himself to literary pursuits. His works are, 1. *L'Abregé Chronologique de l'Histoire Ecclesiastique*, 3 vols, 8vo. written in the manner of the president Henault's History of France, but not possessed of equal spirit and elegance. 2. *Les Annales Romaines*, 1756, 8vo; another chronological abridgement, and much better supported than the former. Into this work the author has introduced every thing most worthy of notice which has been written by Saint Evremond, Abbé Saint-Real, President Montesquieu, Abbé Mably, &c. concerning the Romans; and, if we except a difference of style, which is easily discernible it is, in other respects, a very judicious compilation. 3. *Abregé Chronologique de l'Histoire d'Espagne et de Portugal*, 1759, 1765, in 2 vols, 8vo. This book, in point of accuracy, is worthy of the president Henault, by whom it was begun; but it displays no discrimination of character nor depth of research. The author received assistance from M. Lacombe, whose talents for chronological abridgement are well known. The republic of letters sustained a loss by the death of M. Macquer, which happened on the 27th of January 1770, at the age of 50. As to his character, he was industrious, agreeable, modest, and sincere, and an enemy to all foolish vanity and affectation. He had a cold imagination, but a correct taste. He had an eager thirst for knowledge of every kind, and he had neglected no useful branch of study. He had a share in the Dictionary of Arts and Professions, in 2 vols 8vo, and in the Translation of the Syphilis of Fracastor published by Lacombe.

Macquer, *Pierre Joseph*, brother to the former, was born at Paris the 9th of October 1718, and died there February 16. 1784. He was a member of the Academy of Sciences, and late professor of pharmacy; and was engaged in the *Journal des Sçavans*, for the articles of medicine and chemistry. With the latter science he was intimately acquainted. He had a share in the *Pharmacopœia Parisiensis*, published in 1758, in 4to. His other works are, 1. *Elemens de Chimie theorique*; Paris, 1749, 1753, 12mo; which have been translated into English and German.—2. *Elemens de Chimie pratique*, 1751, 2 vols 12mo. These two works were republished together, in 1756, in 3 vols. 12mo. 3. *Plan d'un cours de Chimie experimentale et raisonée*, 1757, 12mo; in the composition of which he was associated with M. Beaumé. 4. *Formulæ Medicamentorum Magistralium*, 1763. 5. *L'Art de la Teinture en Soie*, 1763. 6. *Dictionnaire de Chimie, contenant la Théorie et la Pratique de cet art*, 1766, 2 vols. 8vo; which has been translated into German, with notes; and into English, with notes, by Mr Keir. Macquer has, by his labours and writings, greatly contributed to render useful an art which formerly tended only to ruin the health of the patient by foreign remedies, or to reduce

reduce the profeffors of it to beggary, while they profecuted the idle dreams of converting every thing into gold.

MACRIN, Salmon, one of the beft Latin poets of the 16th century, was born at Loudun. His true name was *John Salmon;* but he took that of *Macrin*, from his being frequently fo called in ridicule by Francis I. on account of his extraordinary leannefs. He was preceptor to Claudius of Savoy, count of Tende; and to Honorius the count's brother; and wrote feveral pieces of poetry in lyric verfe, which were fo admired, that he was called *the Horace of his time.* He died of old age, at Loudun, in 1555.—*Charles Macrin*, his fon, was not inferior to him as a poet, and furpaffed him in his knowledge of the Greek tongue. He was preceptor to Catharine of Navarre, the fifter of Henry the Great; and perifhed in the maffacre on St Bartholomew's day in 1572.

MACROBII, a people of Ethiopia, celebrated for their juftice, and the innocence of their manners: alfo a people in the ifland Meröe. The Hyperboreans were alfo called *Macrobii:* They generally lived to their 120th year; and from their longevity they obtained their name (μακρος βιος, *long life.*)

MACROBIUS, Ambrosius Aurelius Theodosius, an ancient Latin writer, who flourifhed towards the latter part of the fourth century.—Of what country he was, is not clear: Erafmus, in his Ciceronianus, feems to think he was a Greek; and he himfelf tells us, in the preface to his Saturnalia, that he was not a Roman, but laboured under the inconveniences of writing in a language which was not natural to him. Of what religion he was, Chriftian or Pagan, is uncertain. Barthius ranks him among the Chriftians; but Spanheim and Fabricius fuppofe him to have been a heathen. This, however, is certain, that he was a man of confular dignity, and one of the chamberlains or mafters of the wardrobe to Theodofius; as appears from a refcript directed to Florentius, concerning thofe who were to obtain that office. He wrote a Commentary upon Cicero's *Somnium Scipionis*, and feven books of *Saturnalia*, which treat of various fubjects, and are an agreeable mixture of criticifm and antiquity. He was not an original writer, but made great ufe of other people's works, borrowing not only their materials, but even their language, and for this he has been fatirically rallied by fome modern authors, though rather unfairly, confidering the exprefs declaration and apology which he makes on this head, at the very entrance of his work. "Don't blame me," fays he, "if what I have collected from multifarious reading, I fhall frequently exprefs in the very words of the authors from whom I have taken it: for my view in this prefent work is, not to give proofs of my eloquence, but to collect and digeft into fome regularity and order fuch things as I thought might be ufeful to be known. I fhall therefore here imitate the bees, who fuck the beft juices from all forts of flowers, and afterwards work them up into various forms and orders with fome mixture of their own proper fpirit." The *Somnium Scipionis* and *Saturnalia* have been often printed; to which has been added, in the later editions, a piece entitled *De Differentiis et Societatibus Græci Latinique Verbi.*

MACROCEPHALUS (compounded of μακρος "great," and κεφαλη "head,") denotes a perfon with a head larger or longer than the common fize. Macrocephali, or Long-heads, is a name given to a certain people, who, according to the accounts of authors, were famous for the unfeemly length of their heads: yet cuftom fo far habituated them to it, that inftead of looking on it as a deformity, they efteemed it a beauty, and, as foon as the child was born, moulded and fafhioned its head in their hands to as great a length as poffible, and afterwards ufed all fuch rollers and bandages as might feem moft likely to determine its growing long. The greater part of the iflanders in the Archipelago, fome of the people of Afia, and even fome of thofe of Europe, ftill prefs their children's heads out lengthwife. We may obferve alfo, that the Epirots, many people of America, &c. are all born with fome fingularity in the conformation of their heads; either a flatnefs on the top, two extraordinary protuberances behind, or one on each fide; fingularities which we can only regard as an effect of an ancient and ftrange mode, which at length is become hereditary in the nation. According to the report of many travellers, the operation of compreffing the head of a child lengthwife, while it is yet foft, is with a view infenfibly to enlarge the interval between the two eyes, fo that the vifual rays turning more to the right and left, the fight would embrace a much larger portion of the horizon; the advantage of which they are well acquainted with, either in the conftant exercife of hunting, or on a thoufand other occafions. Ever fince the 16th century, the miffionaries eftablifhed in the countries inhabited by the favages of America, have endeavoured to deftroy this cuftom; and we find in the feffions of the third council of Lima, held in 1585, a canon which exprefsly prohibits it. But if it has been repreffed one way, the free negroes and Maroons, although Africans, have adopted it, fince they have been eftablifhed among the Caribs, folely with the view of diftinguifhing their children, which are born free, from thofe who are born in flavery. The Omaquas, a people of South America, according to P. Veigh, prefs the heads of their children fo violently between two planks that they become quite fharp at the top, and flat before and behind. They fay they do this to give their heads a greater refemblance to the moon.

MACROCERCI, a name given to that clafs of animalcules, which have tails longer than their bodies.

MACROCOLUM, or Macrocollum (formed of μακρος "large," and κολλαω "I join,") among the Romans, the largeft kind of paper then in ufe. It meafured fixteen inches, and frequently two feet.

MACROCOSM, a word denoting the great world or univerfe. It is compounded of the Greek words μακρος "great," and κοσμος "world."

MACROOMP, or Macroom, a town of Ireland, in the barony of Mufkerry, county of Cork, and province of Munfter, 142 miles from Dublin; it is fituated amongft hills, in a dry gravelly limeftone foil.—This place is faid to take its name from an old crooked oak, fo called in Irifh, which formerly grew here. The caftle was firft built in King John's time, foon after the Englifh conqueft (according to Sir Richard Cox), by the Carews; but others attribute it to the Daltons. It was repaired and beautified by Teague Macarty, who died in the year 1565, and was father to the

Macrourus || Madagascar.

the celebrated Sir Cormac Mac Teague mentioned by Camden and other writers as an active perſon in Queen Elizabeth's time. The late earls of Glancarty altered this caſtle into a more modern ſtructure, it being burnt down in the wars of 1641. Oppoſite to the bridge, is the pariſh-church, dedicated to St Colman of Cloyne. Here is a barrack for a foot company, a market-houſe, and handſome Roman Catholic chapel. A conſiderable number of perſons have been employed in this town in combing wool and ſpinning yarn, and ſome ſalt-works have been erected here. At half a mile's diſtance is a ſpa, that riſes on the very brink of a bog; its waters are a mild chalybeate, and are accounted ſerviceable in hypochondriacal caſes, and in cutaneous eruptions. The fairs are four in the year.

MACROURUS, a genus of fiſhes belonging to the order *Thoracici*. See ICHTHYOLOGY *Index*.

MACTATIO, in the Roman ſacrifices, ſignifies the act of killing the victim. This was performed either by the prieſt himſelf, or ſome of his inferior officers, whom we meet with under the names of *popæ*, *agones*, *cultrarii*, and *victimarii*; but, before the beaſt was killed, the prieſt, turning himſelf to the eaſt, drew a crooked line with his knife, from the forehead to the tail. Among the Greeks, this ceremony was performed moſt commonly by the prieſt, or, in his abſence, by the moſt honourable perſon preſent. If the ſacrifice was offered to the celeſtial gods, the victim's throat was bent up towards heaven; if to the infernal, or to heroes, it was killed with its throat towards the ground. The manner of killing the animal was by a ſtroke on the head, and, after it was fallen, thruſting a knife into its throat. Much notice was taken, and good or ill ſucceſs predicted, from the ſtruggles of the beaſt, or its quiet ſubmiſſion to the blow, from the flowing of the blood, and the length of time it happened to live after the fall, &c.

MACULÆ, in *Aſtronomy*, dark ſpots appearing on the luminous ſurfaces of the ſun and moon, and even ſome of the planets. See ASTRONOMY *Index*.

MAD-APPLE. See SOLANUM, BOTANY *Index*.

MADAGASCAR, the largeſt of the African iſlands, is ſituated between 43° and 51° of E. Long. and between 12° and 26° of S. Lat.; extending in length near 1000 miles from north-north-eaſt to ſouth-ſouth-weſt, and about 300 in breadth where broadeſt. It was diſcovered in 1506 by Laurence Almeyda; but the Perſians and the Arabians were acquainted with it from time immemorial under the name of *Serandib*. Alphonzo Albuquerque ordered Ruy Pereira dy Conthinto to viſit the interior parts, and that general intruſted Triſtan d'Acunha with the ſurvey. The Portugueſe called it the iſland of *St Lawrence*; the French who viſited it in the reign of Henry IV. named it *Iſle Dauphine*; its proper name is *Madegaſſe*. It is now, however, by common conſent, called *Madagaſcar*.

This large iſland, according to many learned geographers, is the Cerné of Pliny, and the Menuthiaſde of Ptolemy. It is everywhere watered by large rivers, ſtreams and rivulets, which have their ſources at the foot of that long chain of mountains which runs through the whole extent of the iſland from eaſt to weſt. The two higheſt promontories are called *Vivagora* and *Botiſtmene*.

Theſe mountains (according to the abbé Rochon*) encloſe within their boſoms a variety of precious minerals and uſeful foſſils. The traveller (who for the firſt time rambles over ſavage and mountainous countries, interſected with valleys and with hills, where nature left to herſelf brings forth the moſt ſingular and the moſt varied productions) is involuntarily ſurpriſed and terrified at the ſight of precipices, the ſummits of which are crowned with monſtrous trees, that ſeem coeval with the world. His aſtoniſhment is redoubled at the noiſe of thoſe grand caſcades, the approach to which is generally inacceſſible. But to thoſe views ſo ſublimely pictureſque, rural ſcenes ſoon ſucceed; little hills, gently riſing grounds, and plains, the vegetation of which is never repreſſed by the intemperance or the viciſſitude of the ſeaſons. The eye contemplates with pleaſure thoſe vaſt ſavannas which nouriſh numberleſs herds of bullocks and of ſheep. You behold a flouriſhing agriculture, produced almoſt ſolely by the fertilizing womb of nature. The fortunate inhabitants of Madagaſcar do not bedew the earth with their ſweat; they ſcarcely ſtir the ground with a rake, and even that ſlight preparation is ſufficient. They ſcrape little holes at a ſmall diſtance from each other, into which they ſcatter a few grains of rice, and cover them with their feet; and ſo great is the fertility of the ſoil, that the lands ſown in this careleſs manner produce a hundred fold.

*Voyage à Madagaſcar, &c. Paris 1791.

The foreſts preſent a prodigious variety of the moſt uſeful and the moſt beautiful trees; ebony, wood for dying, bamboos of an enormous thickneſs, and palm trees of every kind. The timber employed in ſhip-building is no leſs common than thoſe kinds ſo much prized by the cabinetmaker. We are told by the French governor Flacourt, in his hiſtory of this iſland†, that in the year 1650 he ſent to France 52,000 weight of aloes of an excellent quality. All of theſe various trees and ſhrubs are ſurrounded by an infinite number of paraſitical plants; muſhrooms of an infinite diverſity of kinds and colours are to be met with everywhere in the woods; and the inhabitants know well how to diſtinguiſh thoſe which are prejudicial to the health. They collect large quantities of uſeful gums and reſins; and out of the milky ſap of a tree, denominated by them *finguiore*, the inhabitants, by means of coagulation, make that ſingular ſubſtance known to naturaliſts by the name of *gum elaſtic*. (See CAOUTCHOUC and JATROPHA.)

† *Hiſt. de la Grand Iſle de Madag.* Paris 1660.

Beſides the aromatic and medicinal herbs which abound in the foreſts, the iſland produces flax and hemp of a length and ſtrength which ſurpaſs any in Europe. Sugar-canes, wax, honey of different kinds, tobacco, indigo, white pepper, gum-lac, ambergris, ſilk, and cotton, would long ſince have been objects of commerce which Madagaſcar would have yielded in profuſion, if the Europeans, in viſiting the iſland, had furniſhed the inhabitants with the neceſſary information for preparing and improving theſe ſeveral productions.

The ſugar-canes (as we are informed by another traveller‡) are much larger and finer than any in the Weſt Indies; being as thick as a man's wriſt, and ſo full of juice, that a foot of them will weigh two pounds. When the natives travel, they carry a ſugar-cane along with them, which will ſupport them for two or three days. Here are alſo plenty of tamarinds; and ſuch quantities of limes and oranges, that very large caſks may

‡ *Ives's Voyage to India*, p. 14.

Madagascar.

may be filled with their juices at a trifling expence, as they may be purchased for iron pots, muskets, powder, ball, &c. During the short time that Admiral Watson's squadron staid here in 1754, Mr Ives preserved about half a hogshead full of those juices, which proved afterwards of the greatest service to the ships crews. It must be observed, however, that no good water is to be had at St Augustine in the south-west part of the island, where ships usually touch, unless boats are sent for it four or five miles up the river; and instead of filling their casks at low water (as is the case in most other rivers), they must begin to fill at about a quarter's flood: The reason assigned for this is, that the river has a communication with the sea at other places besides this of St Augustine's bay; and it has been found by experience, that the sea water brought into the river by the flood tide is not discharged till a quarter's flood of the next tide in St Augustine's bay; and for three miles up the river, the water is always very brackish, if not quite salt.

The abundance and variety of provisions of every kind, which a fine climate and fertile soil can produce, are on no part of the globe, according to M. Rochon, superior to those of Madagascar: game, wild-fowl, poultry, fish, cattle, and fruits, are alike plentiful. The oxen, Mr Ives also informs us, are large and fat, and have each a protuberance of fat between the shoulders, weighing about 20 pounds. Their flesh is greatly esteemed by all the European nations trading to India, and ships are sent to Madagascar on purpose to kill and salt them on the island. The protuberance of fat above mentioned is particularly esteemed after it has lain some time in salt; but our author says, that he could not join in the encomiums either on this piece or the beef in general; as the herbage on which the creatures feed gives their flesh a particular taste, which to him was disagreeable. The sheep differ little from the goats; being equally hairy, only that their heads are somewhat larger: their necks resemble that of a calf, and their tails weigh at least ten pounds. Vast quantities of locusts rise here from the low lands in thick clouds, extending sometimes to an incredible length and breadth. The natives eat these insects, and even prefer them to their finest fish. Their method of dressing them is to strip off their legs and wings, and fry them in oil.

The inhabitants (termed *Melagaches* or *Madecasses*), M. Rochon informs us, are in person above the middle size of Europeans. The colour of the skin is different in different tribes: among some it is of a deep black, among others tawny; some of the natives are of a copper colour, but the complexion of by far the greatest number is olive. All those who are black have woolly hair like the negroes of the coast of Africa: those, on the other hand, who resemble Indians and Mulattoes, have hair equally straight with that of the Europeans; the nose is not broad and flat; the forehead is large and open; in short, all the features are regular and agreeable. Their physiognomy displays the appearance of frankness and of satisfaction; they are desirous only of learning such things as may administer to their necessities; that species of knowledge which demands reflection is indifferent to them; sober, agile, active, they spend the greatest part of their time either in sleep or in amusement. In fine, according to the Abbé, the native of Madagascar, like savages in general, possesses a character equally devoid of vice and of virtue; the gratifications of the present moment solely occupy his reflections; he possesses no kind of foresight whatever; and he cannot conceive the idea that there are men in the world who trouble themselves about the evils of futurity.

The population of the island has been estimated at four millions; but this calculation is thought exaggerated by our author, and indeed it appears incredible to us. Every tribe or society inhabits its own canton, and is governed by its own customs. Each of these acknowledges a chief; this chief is sometimes elective, but more usually hereditary. The lands are not divided and portioned out, but belong to those who are at the trouble of cultivating them. These islanders make use of neither locks nor keys; the principal part of their food consists in rice, fish, and flesh; their rice is moistened with a soup which is seasoned with pimento, ginger, saffron, and aromatic herbs. They display wonderful cunning in catching a variety of birds, many of which are unknown in Europe; they have the pheasant, the partridge, the quail, the pintado, the wild duck, teal of five or six different kinds, the blue hen, the black paroquet, and the turtle-dove, in great plenty; and also a bat of a monstrous size, which is much prized on account of its exquisite flavour. These last are so hideous in their appearance, that they at first terrify the European sailors: but after they have vanquished their repugnance to them, they prize their flesh infinitely before that of the pullets of their own country. The Melagaches also catch an immense quantity of sea-fish: such as the dorado, the sole, the herring, the mackarel, the turtle, &c. with oysters, crabs, &c. The rivers afford excellent eels, and mullets of an exquisite flavour.

The inhabitants near St Augustine's bay, Mr Ives informs us, speak as much broken English as enables them to exchange their provisions for European articles. These, on the part of the Melagaches are cattle, poultry, milk, fruit, rice, salt, porcelain, potatoes, yams, fish, lances, and shells. From the Europeans they receive muskets, powder, bullets, flints, *clouties*, (including handkerchiefs, and linen of all kinds), beads, iron pots, &c.—Silver, which they call *manila*, is in great esteem with them, and is made by them into bracelets for their wives.

That part of the island at which the English squadron touched, is the dominions of the king of *Baba*, who, by the account of Mr Ives, seemed greatly to affect to be an Englishman. They had no sooner touched at the island, than they were waited on by one called *Robin Hood*, and another person, both of whom bore the office of *pursers*. Along with these were *Philibey* the general; John Anderson and Frederic Martin, captains. Nor did the king himself and his family disdain to pay them a visit; who, in like manner were distinguished by English names; the king's eldest son being called the prince of Wales, and the court not being without a duke of Cumberland, a prince Augustus, princesses, &c. as in England. All these grandees came on board naked, excepting only a slight covering about their loins and on their shoulders, made of a kind of grass growing on the island; which they had adorned with small glass beads by way of border or fringe. Their hair resembled that of the

Madagascar.

Indians in being long and black, rather than the woolly heads of the African negroes. "The wives of the Melagaches (according to our author) take great pains with their husbands hair; sometimes putting it in large and regular curls; at other times braiding it in great order, and making it shine with a particular oil which the island produces. The men always carry in their hands a wooden lance headed with iron, which is commonly made very neat; and they are such excellent marksmen, that they will strike with it a very small object at 30 or 40 yards distance. They have also commonly a musket, which they get from Europeans in exchange for cattle, and are always sure to keep in excellent order. I am sorry to say (continues Mr Ives) that the English are frequently guilty of great impositions in this kind of traffic, by disposing of cheap and ill-tempered barrels among the poor inhabitants, who sometimes lose their lives by the bursting of these pieces. Such iniquitous practices as these must in the end prove injurious to the nation; and has indeed already made the name of more than one-half of these traders truly infamous among the deluded but hitherto friendly Madagascarians.

"They are a civil and good-natured people, but easily provoked, and apt to show their resentment on the least provocation, especially when they think themselves injured or slighted. Another characteristic of them is, the very high notions of dignity they entertain of their king; which is carried to such a height, that they are never more sensibly hurt than when they imagine he is treated with incivility or disrespect. This mighty monarch resides in a town built with mud, about 12 miles up the country from St Augustine's bay. On the east side of the bay, as you enter, there resided one Prince William, a relation and tributary to the king; but who in most cases acted as an independent prince, and always used his utmost endeavours with the officers to cause them buy their provisions from him, and not from the king or his subjects. In this prince's territories, not far from the sea, are the remains of a fort built by Avery the pirate.

"All the women of Madagascar, excepting the very poorest sort, wear a covering over their breasts and shoulders, ornamented with glass beads, and none go without a cloth about their loins. They commonly walk with a long slender rod or stick. The men are allowed to marry as many women as they can support.

"During our stay at this island (says Mr Ives), I observed with great concern, several miserable objects in the last stage of the venereal disease. They had not been able to find any cure; and as far as I could learn, their doctors are totally ignorant of medicine. The only method they use for curing all distempers, as well external as internal, is the wearing on the arm or neck a particular charm or amulet; or besmearing the part affected with earth moistened with the juice of some plant or tree, and made up into soft paste.

"I took some pains to learn their religious tenets; and find that they worship one Universal Father; whom, when they speak in English, they call *God;* and in whom they conceive all kinds of perfection to reside. The sun they look upon as a glorious body; and, I believe, as a spiritual being, but created and dependent. They frequently look up to it with wonder, if not with praise and adoration. They make their supplications to the *One* Almighty, and offer sacrifices to him in their distresses. I had the curiosity to attend a sacrifice, at the hut of John Anderson, whose father had for a long time been afflicted with sickness. About sunset an ox was brought into the yard; and the son, who officiated as priest, slew it. An altar was reared nigh, and the post of it was sprinkled with the blood of the victim. The head after its being severed from the body, was placed, with the horns on, at the foot of the altar: the caul was burned on the fire, and most of the pluck and entrails boiled in a pot. The sick man, who was brought to the door, and placed on the ground so as to face the sacrifice, prayed often, and seemingly with great fervency. His eyes were fixed attentively towards the heavens, and his hands held up in a supplicating posture. The ceremony ended with the son's cutting up the ox into small pieces; the greatest part of which he distributed among the poor slaves belonging to his father and himself; reserving, however, some of the best pieces for his own use. Upon the whole, I saw so many circumstances in this Madagascarian sacrifice, so exactly resembling those described in the Old Testament as offered up by the Jews, that I could not turn my thoughts back to the original, without being sensibly struck by the exactness of the copy."

When the squadron first arrived at Madagascar, the king of Baba, a man of about 60 years of age, was ill of the gout. Having demanded of Admiral Watson some presents, the latter complimented him, among other things, with some brandy. The monarch then asked him if he had any doctor with him, and if he was a great doctor, and a king's doctor? To all which being answered in the affirmative, he desired him to bring some *mahomets* (medicines) for his sick knee. With this requisition Mr Ives designed to comply; but having waited until some officers should be ready to accompany him, his majesty, in the mean time, took such a dose of brandy as quickly sent the gout into his head, and occasioned his death. Mr Ives observes, that it happened very luckily for him that the monarch's decease happened without his having taken any of the medicines intended for him, as it would have been impossible to avoid the imputation of having poisoned him, which would certainly have been resented by his loyal subjects.

The king's death occasioned great confusion; the grandees being desirous that it should be concealed for some time. This, however, was found impossible; on which they set off for the *Mud Town* about 11 o'clock the same evening. All the inhabitants of the village followed their example; leaving only the dogs, who set up the most hideous howling. Captain Frederic Martin coming to take leave of the English, begged with great earnestness for a fresh supply of gunpowder; whispering that the king was dead, and that they should in all probability go to war about making another. They had been formerly told, that one who had the title of *duke* of Baba would certainly succeed to the throne; but they afterwards learned, that Philibey the general having espoused the cause of *Raphani* the late king's son, and taken him under his tutelage and protection, this youth, who was only about

16 years of age, fucceeded his father as king of Baba.

The following is a defcription of the fouthern divifion of the ifland, from the Abbé Rochon.

"That part of Madagafcar in which Fort Dauphin is fituated is very populous. Almoft all the villages are placed on eminences, and furrounded with two rows of ftrong palifadoes, fomewhat in the manner of fuch of our fences as are compofed of hurdles and turf. Within, is a parapet of folid earth about four feet in height; large pointed bamboos placed at the diftance of five feet from each other, and funk in a pit, form a kind of loop-holes, which contribute towards the defence of thefe villages, fome of which are befides fortified with a ditch ten feet in breadth and fix in depth. The dwelling of the chief is called a *donac*. When the chiefs go abroad, they are always provided with a mufket and a ftick armed with iron, and adorned at the extremity with a little tuft of cow's hair. They wear a bonnet of red wool. It is chiefly by the colour of their bonnet that they are diftinguifhed from their fubjects. Their authority is extremely limited: however, in the province of *Carcanoffi*, the lands by cuftom belong to their chiefs, who diftribute them among their fubjects for the purpofes of cultivation; they exact a trifling quit-rent in return, which in their language is called *faenfa*. The people of Carcanoffi are not altogether ignorant of the art of writing; they even poffefs fome hiftorical works in the Madagafcar tongue: but their learned men, whom they term *Ombiaffes*, make ufe of the Arabic characters alone. They have treatifes on medicine, geomancy, and judicial aftrology; the moft renowned live in the province of *Matatane*; it is in that diftrict that magic ftill remains in all its glory; the Matanes are actually dreaded by the other Madecaffees on account of their excellence in this delufive art. The Ombiaffes have public fchools in which they teach geomancy and aftrology. The natives have undoubtedly learned the art of writing from the Arabians, who made a conqueft of this ifland about 300 years fince.

"The people of the province of *Anoffi*, near Fort Dauphin, are lively, gay, fenfible, and grateful; they are paffionately fond of women; are never melancholy in their company; and their principal occupation is to pleafe the fex; indeed, whenever they meet their wives, they begin to fing and dance. The women, from being happy, are always in good humour. Their lively and cheerful character is extremely pleafing to the Europeans. I have often been prefent at their affemblies, where affairs of importance have been agitated; I have obferved their dances, their fports, and their amufements, and I have found them free from thofe exceffes which are but too common among polifhed nations. Indeed I was too young as this time for my obfervations to be of much weight; but if my experience be infufficient to infpire confidence, I beg the reader will rather confider the nature of things, than the relations given by men without principles or intelligence, who fancy that they have a right to tyrannize over the inhabitants of every country which they can fubdue. If the people of Madagafcar have fometimes availed themfelves of treachery, they have been forced to it by the tyranny of the Europeans. The weak have no other arms againft the ftrong. Could they defend themfelves by any other means from our artillery and bayonets? They are uninformed and helplefs; and we avail ourfelves of their weaknefs, in order to make them fubmit to our covetoufnefs and caprice. They receive the moft cruel and oppreffive treatment, in return for the hofpitality which they generoufly beftow on us; and we call them traitors and cowards, when we force them to break the yoke with which we have been pleafed to load them."

In the fecond volume of Count Benyowfky's Memoirs and Travels we have the following account of the religion, government, &c. of the people of this ifland.

"The Madagafcar nation believe in a Supreme Being, whom they call *Zanhare*, which denotes creator of all things. They honour and revere this Being; but have dedicated no temple to him, and much lefs have they fubftituted idols. They make facrifices, by killing oxen and fheep, and they addrefs all thefe libations to God. It has been afferted, that this nation likewife makes offerings to the devil: but in this there is a deception; for the piece of the facrificed beaft which is ufually thrown into the fire is not intended in honour of the devil, as is ufually pretended. This cuftom is very ancient, and no one can tell the true reafon of it. With regard to the immortality of the foul, the Madagafcar people are perfuaded, that, after their death, their fpirit will return again to the region in which the Zanhare dwells; but they by no means admit that the fpirit of man, after his death, can fuffer any evil. As to the diftinction of evil or good, they are perfuaded that the good and upright man fhall be recompenfed, in this life, by a good ftate of health, the conftancy of his friends, the increafe of his fortunes, the obedience of his children, and the happinefs of beholding the profperity of his family: and they believe that the wicked man's fate fhall be the contrary to this. The Madagafcar people, upon this conviction, when they make oaths, add benedictions in favour of thofe who keep them, and curfes againft thofe who break them. In this manner it is that they appeal to the judgement of Zanhare, in making agreements; and it has never been known, or heard of, that a native of Madagafcar has broken his oath, provided it was made in the ufual manner, which they fay was prefcribed by their forefathers.

"As to their kings and form of government, &c. the Madagafcar people have always acknowledged the line of Ramini, as that to which the rights of Ampanfacabe or fovereign belongs. They have confidered this line as extinct fince the death of Dian Ramini Larizon, which happened 66 years ago, and whofe body was buried upon a mountain, out of which the river Manangourou fprings; but having acknowledged the heir of this line on the female fide, they re-eftablifhed this title in the year 1776. The right of the Ampanfacabe confifts in nominating the Rohandrians to affift in the cabars, at which all thofe who are cited are bound to appear, and the judgement of the Ampanfacabe in his cabar is decifive. Another prerogative of the Ampanfacabe is, that each Rohandrian is obliged to leave him by will a certain proportion of his property, which the fucceffors ufually purchafe by a flight tribute or fine. Thirdly, The Ampanfacabe has a right to exact from each Rohandrian one tenth

Madagascar.

tenth of the produce of his land, and a number of horned cattle and slaves, in proportion to the riches of the country possessed by each Rohandrian. The second order is composed of the Rohandrians, or princes. Since the loss of the Ampansacabe, three of these Rohandrians have assumed the title of *kings*, namely the Rohandrian of the province of Mahavelou, named *Hiavi;* of the province of Voemar, named *Lambouin;* and a third at Bombetoki, named *Cimanounpou.* The third order consists of the Voadziri, or lords of a district, composed of several villages. The fourth order consists of the Lohavohits, or chiefs of villages. The fifth order, Ondzatzi, who are freemen, compose the attendants or followers of the Rohandrians, Voadziri, or Lohavohits. The sixth order consists of Ombiasses, or learned men; and this order forms the warriors, workmen, physicians, and diviners: these last possess no charge. The seventh order consists of Ampurias or slaves.

"Having made inquiries from Bombetoki passing to the northward, and as far as Itapere, the result proved that there are 38 Rohandrians actually reigning, and 287 Voadziri. With respect to the Lohavohits, Ondzatzi, and Ombiasses, it was not possible to obtain any accurate determination of their number. These orders preserve a regular gradation, respecting which it would be very difficult to give a detailed account. They live in the manner we read of concerning the ancient patriarchs. Every father of a family is priest and judge in his own house, though he depends upon the Lohavohits, who superintends his conduct. This last is answerable to his Voadziri, and the Voadziri to the Rohandrian.

"The Madagascar people having no communication with the main land of Æthiopia, have not altered their primitive laws; and the language throughout the whole extent of the island is the same. It would be a rash attempt to determine the origin of this nation; it is certain that it consists of three distinct races, who have for ages past formed intermixtures which vary to infinity. The first race is that of Zafe Ibrahim, or descendants of Abraham; but they have no vestige of Judaism, except circumcision, and some names, such as Isaac, Reuben, Jacob, &c. This race is of a brown colour.—The second race is that of Zaferamini: with respect to this, some books which are still extant among the Ombiasses, affirm that it is not more than six centuries since their arrival at Madagascar.—With respect to the third race of Zafe Canambou, it is of Arabian extraction, and arrived much more lately than the others from the coasts of Æthiopia: hence it possesses neither power nor credit, and fills only the charges of writers, historians, poets, &c.

"In regard to arts and trades, the Madagascar nation are contented with such as are necessary to make their moveables, tools, utensils, and arms for defence; to construct their dwellings, and the boats which are necessary for their navigation; and lastly, to fabricate cloths and stuffs for their clothing. They are desirous only of possessing the necessary supplies of immediate utility and convenience. The principal and most respected business, is the manufacture of iron and steel. The artists in this way call themselves *ampanesa vilie.* They are very expert in fusing the ore, and forging utensils, such as hatchets, hammers, anvils, knives, spades, sagayes, razors, pincers or tweezers for pulling out the hair, &c. The second class consists of the goldsmiths (*ompanesa vola mena*): they cast gold in ingots, and make up bracelets, buckles, earrings, drops, rings, &c. The third are called *ompavillanga,* and are potters. The fourth are the *ompanevatta,* or turners in wood, who make boxes called *vatta,* plates, wooden and horn spoons, bee-hives, coffins, &c. The fifth *ompan cacasou,* or carpenters. They are very expert in this business, and make use of the rule, the plane, the compasses, &c. The sixth are the *ompaniavi,* or ropemakers. They make their ropes of different kinds of bark of trees, and likewise of hemp. The seventh, *ampan lamba,* or weavers. This business is performed by women only, and it would be reckoned disgraceful in a man to exercise it. The *ombiasses* are the literary men and physicians, who give advice only. The *herauvitz* are comedians and dancers.

"The Madagascar people always live in society; that is to say, in towns and villages. The towns are surrounded by a ditch and pallisades (as already mentioned), at the extremities of which a guard of from 12 to 20 armed men is kept. The houses of private people consist of a convenient cottage, surrounded by several small ones: the master of the house dwells in the largest, and his women or slaves lodge in the smaller. These houses are built of wood, covered with leaves of the palm tree or straw.

"The houses of the great men of the country are very spacious; each house is composed of two walls and four apartments: round about the principal house other smaller habitations are built for the accommodation of the women, and the whole family of the chief; but the slaves cannot pass the night within them.—Most of the houses inhabited by the Rohandrians are built with taste and admirable symmetry."

The French attempted to conqner and take possession of the whole island, by order, and for the use of, their Most Christian Majesties Louis XIII. and XIV. and they maintained a footing on it from the year 1642 to 1657. During this period, by the most cruel treachery, they taught the native princes the barbarous traffic in slaves, by villanously selling to the Dutch governor of Mauritius a number of innocent people, who had been assisting them in forming a settlement at Fort Dauphin.

The Abbé Rochon tells us, that the insalubrity of the air in Madagascar determined his countrymen in 1664 to quit that immense island, in order to establish themselves at so inconsiderable a place as the isle of Bourbon, which is scarcely perceptible in a map of the globe: but it is apparent, from the account of the state of the French affairs on the island of Madagascar, in 1661, when Flacourt's narrative was published, that their ill treatment of the natives had raised such a general and formidable opposition to their residence in the country, that the French were obliged to abandon their possessions for other reasons than the unhealthy qualities of the climate. We have not room here for a detail of all the oppressive measures of the French, which the abbé himself candidly censures in the strongest terms; but shall extract the following narrative, both because it is interesting in itself, and exhibits the causes and the means of their expulsion.

La

La Case, one of the French officers employed by the governor of Fort Dauphin against the natives, was so successful in all his enterprises, that they called him *Deaan Pous*, the name of a chief who had formerly conquered the whole island. The French governor, jealous of his renown, treated him harshly, and refused to allow him the rank or honours due to his valour. The sovereign of the province of Amboulle, called *Deaan Rascitat*, taking advantage of his discontent, prevailed on him to become his general. Five Frenchmen followed him. Deaan Nong, the daughter of Rascitat, captivated by the person and heroism of La Case, offered him her hand with the consent of her father. The chief, grown old, infirm, and arrived at the last stage of existence, had the satisfaction of securing the happiness of his subjects, by appointing his son-in-law absolute master of the rich province of Amboulle. La Case, in marrying Deaan Nong, refused to take the titles and honours attached to the sovereign power: he would accept of no other character, than that of the first subject of his wife, who was declared sovereign at the death of her father. Secure in the affection of this princess, who was not only possessed of personal charms, but of courage and great qualities, he was beloved and respected by her family, and by all the people of Amboulle, who reverenced him as a father; and yet, how much soever he wished it, he was unable to contribute to the prosperity of his countrymen at Fort Dauphin, whom he knew to be in the utmost distress. The governor, regarding him as a traitor, had set a price on his head, and on the heads of the five Frenchmen who had followed him. The neighbouring chiefs, irritated at this treatment of a man whom they so much venerated, unanimously refused to supply the fort with provisions. This occasioned a famine in the place, which, with a contagious fever and other maladies, reduced the French garrison to 80 men.

The establishment at Fort Dauphin, on the point of being totally destroyed, was preserved for a short time from ruin by the arrival of a vessel from France, commanded by Kercadio an officer of Britanny, who, with the assistance of a young advocate who had been kidnapped on board the vessel, prevailed on the envious and implacable governor Chamargou to make peace with La Case and his sovereign spouse Deaan Nong. This peace, however, lasted but for a short time; the French, restless and insolent to the neighbouring nations, again drew on them the vengeance of the natives. Even the few friends whom they had been able to acquire by means of La Case, were rendered hostile to them by the tyrannic zeal of the missionaries; who, not contented with being tolerated and allowed to make converts, insisted on Deaan Manang, sovereign of Mandrarey, a powerful, courageous, and intelligent chief, well disposed to the French, to divorce all his wives but one. This prince, not convinced of the necessity of such a measure, assured them that he was unable to change his habits and way of living, which were those of his forefathers. "You would allow me (says he) to have one wife; but if the possession of one woman is a blessing, why should a numerous seraglio be an evil, while peace and concord reign among those of whom it is composed? Do you see among us any indications of jealousy or hatred? No, all our women are gentle; all try to make me happy; and I am more their slave than their master." This speech had no effect on Father Stephen, superior of the Madagascar mission. He peremptorily ordered him instantly to repudiate all his wives except one; and threatened, in presence of the women, to have them taken from him by the French soldiers, if he hesitated in complying with his commands. It is easy to imagine, says M. Rochon, with what indignation this language must have been heard in the *donac* or palace of this prince. The females assailed the missionary on all sides; loaded him with execrations and blows; and, in their fury, would doubtless have afforded him no more quarter than the Thracian women did Orpheus, if Deaan Manang, notwithstanding his own agitation, had not made use of all his authority to save him.

In order to free himself from the persecution of this priest, he removed with his family 70 or 80 miles up into the country; but he was soon followed by Father Stephens and another missionary, with their attendants. The chief, Manang, still received them civilly; but he intreated them no longer to insist on the conversion of him and his people, as it was impossible to oblige them to quit the customs and manners of their ancestors. The only reply which Father Stephen made to this intreaty, was by tearing off the *oli*, and the amulets and charms which the chief wore as sacred badges of his own religion; and, throwing them into the fire, he declared war against him and his nation. This violence instantly cost him and his followers their lives: they were all massacred by order of Manang, who vowed the destruction of all the French in the island; in which intention he proceeded in a manner that has been related by an eyewitness, who was afterwards provincial commissary of artillery, in a narrative published at Lyons in 1722, entitled, *Voyage de Madagascar*. "Our yoke (says the Abbé Rochon) was become odious and insupportable. Historians, for the honour of civilized nations, should bury in oblivion the afflicting narratives of the atrocities exercised on these people, whom we are pleased to call barbarous, treacherous, and deceitful, because they have revolted against European adventurers, whose least crime is that of violating the sacred rites of hospitality."

It was about the year 1672 that the French were totally driven from the island of Madagascar; and no considerable attempts were made to form fresh establishments there till within these few years, by M. de Modave, and by Count Benyowski; neither of which was attended with success, for reasons given by the Abbé, but which we have not room to detail.

MADDER, a plant used in dyeing. See RUBIA, BOTANY *Index*; and for its dyeing properties, see DYEING.

MADEIRAS, a cluster of islands situated in the Atlantic ocean in W. Long. 16°, and between 32° and 33° N. Lat.—The largest of them, called *Madeira*, from which the rest take their name, is about 55 English miles long, and 10 miles broad; and was first discovered on the 2d of July, in the year 1419, by Joao Gonzales Zarco, there being no historical foundation for the fabulous report of its discovery by one Machin an Englishman. It is divided into two capitanias, named *Funchal* and *Maxico*, from the towns of

Madeiras. those names. The former contains two judicatures, viz. Funchal and Galhetta; the latter being a town with the title of a county, belonging to the family of Castello Melhor. The second capitania likewise comprehends two judicatures, viz. Maxico (read Mashico) and San Vicente.

Funchal is the only citadel or city in the island, which has also seven villas or towns; of which there are four, Calhetta, Camara de Lobos, Ribeira Braba, and Ponta de Sol in the capitania of Funchal, which is divided into 26 parishes. The other three are in the capitania of Maxico, which consists of 17 parishes; these towns are called *Maxico*, *San Vicente*, and *Santa Cruz*.

There is one curiosity in the town of Funchal, which deserves to be taken notice of, and that is a chamber in one of the corners of the Franciscan convent, the walls and ceiling of which are completely covered with rows of human skulls and human thigh bones, so arranged that in the obtuse angle made by each pair of the latter, crossing each other obliquely, is placed a skull. The only vacant space that appears is in the centre of the side opposite to the door, on which there is an extraordinary painting above a kind of altar, but what the subject it is intended to represent, it is difficult to determine. A figure probably intended for St Francis, the patron saint, seems to be intent on trying in a balance the comparative weight of a sinner and a saint. A dirty lamp suspended from the ceiling, and just glimmering in the socket, serves dimly to light up this dismal den of skulls. The monk who attends as shewman, is careful to impress on the minds of those who visit it, the idea that they are all relicks of holy men who died on the island, although Mr Barrow is of opinion that the church-yard must have been frequently robbed, in order to accumulate such a prodigious number of skulls, which from a rough computation made by that gentleman, could not be under 3000.

The governor is at the head of all the civil and military departments of this island, of Porto-Santo, the Salvages, and the Ilhas Desartas; which last only contain the temporary huts of some fishermen, who resort thither in pursuit of their business; his salary is computed to be worth 2000l. per annum, 200l. of which is in the form of a present from the English merchants.

The law department is under the corregidor, who is appointed by the king of Portugal, commonly sent from Lisbon, and holds his place during the king's pleasure. All causes come to him from inferior courts by appeal. Each judicature has a senate; and a *Juiz* or judge, whom they choose, presides over them. At Funchal he is called *Juiz da Fora;* and in the absence, or after the death of the corregidor, acts as his deputy. The foreign merchants elect their own judges, called the *Providor*, who is at the same time collector of the king's customs and revenues, which amount in all to about 12,000l. sterling. Far the greatest part of this sum is applied towards the salaries of civil and military officers, the pay of troops, and the maintenance of public buildings. This revenue arises, first from the tenth of all the produce of this island belonging to the king, by virtue of his office as grand master of the order of Christ; secondly, From ten per cent. duties laid on all imports, provisions excepted; and lastly, From the eleven per cent. charged on all exports. Madeiras.

The island has but one company of regular soldiers of 100 men: the rest of the military force is a militia consisting of 3000 men, divided into companies, each commanded by a captain, who has one lieutenant under him and one ensign. There is no pay given to either the private men or the officers of this militia; and yet their places are much sought after, on account of the rank which they communicate. These troops are embodied once a-year, and exercised once a-month. All the military are commanded by the *Serjeante Mór*. The governor has two *Capitanos de Sal* about him, who do duty as aides de-camp.

The secular priests on the island are about 1200, many of whom are employed as private tutors. Since the expulsion of the Jesuits, no regular public school is to be found here; unless we except a seminary, where a priest, appointed for that purpose, instructs and educates ten students at the king's expence. These wear a red cloak over the usual black gowns worn by ordinary students. All those who intend to go into orders, are obliged to qualify themselves by studying in the university of Coimbra, lately re-established in Portugal. There is also a dean and chapter at Madeira, with a bishop at their head, whose income is considerably greater than the governor's; it consists of 110 pipes of wine, and of 40 muys of wheat, each containing 24 bushels; which amounts in common years to 3000l. sterling. Here are likewise 60 or 70 Franciscan friars, in four monasteries, one of which is at Funchal. About 300 nuns live on the island, in four convents, of the order of Merci, Sta Clara, Incarnacao, and Dom Jesus. Those of the last mentioned institution may marry whenever they choose, and leave their monastery.

In the year 1768, the inhabitants living in the 43 parishes of Madeira, amounted to 63,913, of whom there were 31,341 males and 32,572 females. But in that year 5243 persons died, and no more than 2198 children were born; so that the number of the dead exceeded that of the born by 3045. It is highly probable that some epidemical distemper carried off so disproportionate a number in that year, as the island would shortly be entirely depopulated if the mortality were always equal to this. Another circumstance concurs to strengthen this supposition, namely, the excellence of the climate. The weather is in general mild and temperate: in summer, the heat is very moderate on the higher parts of the island, whither the better sort of people retire for that season; and in the winter the snow remains there for several days, whilst it is never known to continue above a day or two in the lower parts.

The common people of this island are of a tawny colour, and well shaped; though they have large feet, owing perhaps to the efforts they are obliged to make in climbing the craggy paths of this mountainous country. Their faces are oblong, their eyes dark; their black hair naturally falls in ringlets, and begins to crisp in some individuals, which may perhaps be owing to intermarriages with negroes; in general, they are hard featured, but not disagreeable. Their women are too frequently ill-favoured, and want the florid complexion, which, when united to a pleasing assemblage

blage

Madeiras.

blage of regular features, gives our northern fair ones the ſuperiority over all their ſex. They are ſmall, have prominent cheek bones, large feet, an ungraceful gait, and the colour of the darkeſt brunette. The juſt proportion of the body, the fine form of their hands, and their large lively eyes, ſeem in ſome meaſure to compenſate for thoſe defects. The labouring men, in ſummer, wear linen trowſers, a coarſe ſhirt, a large hat, and boots; ſome have a ſhort jacket made of cloth, and a long cloak, which they ſometimes carry over their arm. The women wear a petticoat, and a ſhort corſelet or jacket, cloſely fitting their ſhapes, which is a ſimple, and often not an inelegant, dreſs. They have alſo a ſhort but wide cloak; and thoſe that are unmarried tie their hair on the crown of their head, on which they wear no covering.

The country people are exceeding ſober and frugal; their diet in general conſiſting of bread and onions, or other roots, and little animal food. However, they avoid eating tripe, or any offals, becauſe it is proverbially ſaid of a very poor man, "He is reduced to eat tripe." Their common drink is water, or an infuſion of the remaining rind or ſkin of the grape (after it has paſſed through the wine preſs), which when fermented acquires ſome tartneſs and acidity, but cannot be kept very long. The wine for which the iſland is ſo famous, and which their own hands prepare, ſeldom if ever regales them.

Their principal occupation is the planting and raiſing of vines; but as that branch of agriculture requires little attendance during the greateſt part of the year, they naturally incline to idleneſs. The warmth of the climate, which renders great proviſion againſt the inclemencies of weather unneceſſary, and the eaſe with which the cravings of appetite are ſatisfied, muſt tend to indolence, wherever the regulations of the legiſlature do not counteract it, by endeavouring, with the proſpect of increaſing happineſs, to infuſe the ſpirit of induſtry. It ſeems the Portugueſe government does not purſue the proper methods againſt this dangerous lethargy of the ſtate. They have lately ordered the plantation of olive trees here, on ſuch ſpots as are too dry and barren to bear vines; but they have not thought of giving temporary aſſiſtance to the labourers, and have offered no premium by which theſe might be induced to conquer their reluctance to innovations and averſion to labour.

The vineyards are held only on an annual tenure, and the farmer reaps but four-tenths of the produce, ſince other four tenths are paid in kind to the owner of the land, one tenth to the king, and one to the clergy. Such ſmall profits, joined to the thought of toiling merely for the advantage of others, if improvements were attempted, entirely preclude the hopes of a future increaſe. Oppreſſed as they are, they have however preſerved a high degree of cheerfulneſs and contentment; their labours are commonly alleviated with ſongs, and in the evening they aſſemble from different cottages to dance to the drowſy muſic of a guitar.

The inhabitants of the towns are more ill-favoured than the country people, and often pale and lean. The men wear French clothes, commonly black, which do not ſeem to fit them, and have been in faſhion in the polite world about half a century ago. Their ladies are delicate, and have agreeable features: but the characteriſtic jealouſy of the men ſtill locks them up, and deprives them of a happineſs which the country women, amidſt all their diſtreſſes, enjoy. Many of the better people are a ſort of *petite nobleſſe*, which we would call *gentry*, whoſe genealogical pride makes them unſociable and ignorant, and cauſes a ridiculous affectation of gravity. The landed property is in the hands of a few ancient families, who live at Funchal, and in the various towns on the iſland.

Madeira conſiſts of one large mountain, whoſe branches riſe everywhere from the ſea towards the centre of the iſland, converging to the ſummit, in the midſt of which is a depreſſion or excavation, called the *Val* by the inhabitants, always covered with a freſh and delicate herbage. The ſtones on the iſland ſeem to have been in the fire, are full of holes, and of a blackiſh colour; in ſhort, the greater part of them are lava. A few of them are of the kind which the Derbyſhire miners call *dunſtone*. The ſoil of the whole iſland is a tarras mixed with ſome particles of clay, lime, and ſand, and has much the ſame appearance as ſome earths on the iſle of Aſcenſion. From this circumſtance, and from the excavation of the ſummit of the mountain, it is probable, that in ſome remote period a volcano has produced the lava and the ochreous particles, and that the Val was formerly its crater.

Many brooks and ſmall rivulets deſcend from the ſummits in deep chaſms or glens, which ſeparate the various parts of the iſland. The beds of the brooks are in ſome places covered with ſtones of all ſizes, carried down from the higher parts by the violence of winter rains or floods of melted ſnow. The water is conducted by wears and channels in the vineyards, where each proprietor has the uſe of it for a certain time; ſome being allowed to keep a conſtant ſupply of it, ſome to uſe it thrice, others twice, and others only once a-week. As the heat of the climate renders this ſupply of water to the vineyards abſolutely neceſſary, it is not without great expence that a new vineyard can be planted; for the maintenance of which, the owners muſt purchaſe water at a high price, from thoſe who are conſtantly ſupplied, and are thus enabled to ſpare ſome of it.

Wherever a level piece of ground can be contrived in the higher hills, the natives make plantations of eddoes encloſed by a kind of dike to cauſe a ſtagnation, as that plant ſucceeds beſt in ſwampy ground. Its leaves ſerve as food for hogs, and the country people uſe the roots for their own nouriſhment.

The ſweet potato is planted for the ſame purpoſe, and makes a principal article of diet; together with cheſnuts, which grow in extenſive woods, on the higher parts of the iſland, where the vine will not thrive. Wheat and barley are likewiſe ſown, eſpecially in ſpots where the vines are decaying through age, or where they are newly planted. But the crops do not produce above three months proviſions; and the inhabitants are therefore obliged to have recourſe to other food, beſides importing conſiderable quantities of corn from North America in exchange for wine. The want of manure, and the inactivity of the people, are in ſome meaſure the cauſes of this diſadvantage; but ſuppoſing huſbandry to be carried to its perfection, here, they could not raife corn fufficient for their confumption. They make their threfhing-floors of a circular form, in a corner of a field, which is cleared and beaten folid for the purpofe. The fheaves are laid round about it; and a fquare board, ftuck full of fharp flints below, is dragged over them by a pair of oxen, the driver getting on it to increafe its weight. This machine cuts the ftraw as if it had been chopped, and frees the grain from the hufk, from which it is afterwards feparated.

The great produce of Madeira is the wine, from which it has acquired fame and fupport. Where the foil, expofure, and fupply of water, will admit of it, the vine is cultivated. One or more walks, about a yard or two wide, interfect each vineyard, and are included by ftone walls two feet high. Along thefe walks, which are arched over with laths about feven feet high, they erect wooden pillars at regular diftances, to fupport a lattice-work of bamboos, which flopes down from both fides of the walk, till it is only a foot and a half or two feet high, in which elevation it extends over the whole vineyard. The vines are in this manner fupported from the ground, and the people have room to root out the weeds which fpring up between them. In the feafon of the vintage, they creep under this lattice-work, cut off the grapes, and lay them into bafkets: fome bunches of thefe grapes weigh fix pounds and upwards. This method of keeping the ground clean and moift, and ripening the grapes in the fhade, contributes to give the Madeira wines that excellent flavour and body for which they are remarkable. The owners of vineyards are however obliged to allot a certain fpot of ground for the growth of bamboos; for the lattice-work cannot be made without them: and it is faid fome vineyards lie quite neglected for want of this ufeful reed.

The wines are not all of equal goodnefs, and confequently of different prices. The beft, made of a vine imported from Candia by order of the Infante of Portugal, Don Henry, is called *Madeira Malmfey*, a pipe of which cannot be bought on the fpot for lefs than 40l. or 42l. fterling. It is an exceeding rich fweet wine, and is only made in a fmall quantity. The next fort is a dry wine, fuch as is exported for the London market, at 30l. or 31l. fterling the pipe. Inferior forts for the Eaft India, Weft India, and North American markets, fell at 28l. 25l. and 20l. fterling. About 30,000 pipes, upon a mean, are made every year, each containing 110 gallons. About 13,000 pipes of the better forts are exported: and all the reft is made into brandy for the Brazils, converted into vinegar, or confumed at home.

The largeft quantity of this article exported in the courfe of one year, is faid to have amounted to 15,000 pipes, valued at 500,000l. of which 5,500 pipes were fent to the Eaft Indies, 4,500 to England, 3,000 to to the Weft Indies, and 2,000 to America.

The enclofures of the vineyards confift of walls, and hedges of prickly pear, pomegranates, myrtles, brambles, and wild rofes. The gardens produce peaches, apricots, quinces, apples, pears, walnuts, chefnuts, and many other European fruits; together with now and then fome tropical plants, fuch as bananas, goavas, and pine-apples.

All the common domeftic animals of Europe are likewife found at Madeira; and their mutton and beef, though fmall, is very well tafted. Their horfes are fmall, but fure-footed; and with great agility climb the difficult paths, which are the only means of communication in the country. They have no wheel-carriages of any kind: but in the town they ufe a fort of drays or fledges, formed of two pieces of plank joined by crofs pieces, which make an acute angle before; thefe are drawn by oxen, and are ufed to tranfport cafks of wine, and other heavy goods, to and from the warehoufes.

The animals of the feathered tribe, which live wild here, are more numerous than the wild quadrupeds; there being only the common gray rabbit here, as a reprefentative of the laft-mentioned clafs. Tame birds, fuch as turkeys, geefe, ducks, and hens, are very rare, which is perhaps owing to the fcarcity of corn.

There are no fnakes whatfoever in Madeira; but all the houfes, vineyards, and gardens, fwarm with lizards. The friars of one of the convents complained to Mr Forfter, that thefe vermine deftroyed the fruit in their garden; they had therefore placed a brafs-kettle in the ground to catch them, as they are conftantly running about in queft of food. In this manner they daily caught hundreds, which could not get out on account of the fmooth fides of the kettle, but were forced to perifh.

The fhores of Madeira, and of the neighbouring Salvages and Defertas, are not without fifh; but as they are not in plenty enough for the rigid obfervance of Lent, pickled herrings are brought from Gottenburg in Englifh bottoms, and falted cod from New York and other American ports, to fupply the deficiency.

MADIAN, in *Ancient Geography*, a town of Arabia Petræa, near the Arnon; fo called from one of the fons of Abraham by Ketura, in ruins in Jerome's time. Jerome mentions another MADIAN, or MIDIAN, beyond Arabia, in the defert, to the fouth of the Red fea; and hence *Madianæi*, and *Madianitæi*, the people; and *Madianæa Regio*, the country.

MADNESS, a moft dreadful kind of delirium, without fever. See MEDICINE *Index*.

MADRAS. See *St George*.

MADRE DE POPA, a town and convent of South America, in Terra Firma, feated on the river Grande. It is almoft as much reforted to by pilgrims of America as Loretto is in Europe; and the image of the Virgin Mary is faid to have done many miracles in favour of the feafaring people. W. Long. 76. 0. N. Lat. 11. 0.

MADREPORA, in *Natural Hiftory*, the name of a genus of fubmarine fubftances; belonging to the order lithophyta. See HELMINTHOLOGY *Index*.

MADRID, a town of New Caftile in Spain, and capital of the whole kingdom, though it never had the title of a *city*, is fituated in W. Long. 3. 5. N. Lat. 40. 26. It ftands in the centre of a large plain, furrounded with mountains, and in the very heart of Spain, on the banks of the little river Manzanares, which is always very low and fhallow, except when it is fwelled by the melting of the fnow on the mountains. The city is in general well laid out; the ftreets are very handfome; and the houfes are fair and lofty, but built of brick, with lattice-windows, excepting thofe of the rich, Madrid.

rich, who have glaſs in their windows; only, during the ſummer heats, they uſe gauze, or ſome ſuch thin ſtuff, inſtead of it, to let in the freſh air. There are two ſtately bridges here over the Manzanares, a great many magnificent churches, convents, hoſpitals, and palaces. The royal palace, which ſtands on the weſt ſide of the town, on an eminence, is ſpacious and magnificent, conſiſting of three courts, and commanding a fine proſpect. At the eaſt end of the town is the prado, or pardo; which is a delightful plain, planted with regular rows of poplar trees, and watered with a great many fountains; where the nobility and gentry take the air on horſeback, or in their coaches, and the common people on foot, or divert themſelves with a variety of ſports and exerciſes. Almoſt all the ſtreets of Madrid are ſtraight, wide, clean, and well paved. The largeſt and moſt frequented are the ſtreet of Alcala, that of Atocha, that of Toledo, and the *Calle Grande* or great ſtreet. Madrid has alſo ſeveral ſquares, which in general are not very regular. The principal are thoſe of San Joachim, Sol, Laſganitas, San Domingo, La Cevado, and the Plaza Mayor. The latter eſpecially deſerves notice for its ſpacioufneſs and regularity, and the elegant and lofty houſes it contains. It is 1536 feet in circuit. The houſes, of which there are 136, are of five ſtories, ornamented with balconies; the firſt of which, ſupported by pillars, forms a piazza round the ſquare, where the inhabitants may walk under cover. In the middle of the ſquare a market is kept.—The ſtreets and ſquares of Madrid, except the Plaza Mayor which has been juſt deſcribed, are ornamented with fountains in a very ill taſte. Thoſe moſt to be diſtinguiſhed in this particular are the fountain of the ſmall irregular ſquare called *Plaza di Antonio Martin*, and that of the ſquare named *Puerta del Sol.* The others are not more magnificent though leſs ridiculous. The water of all theſe fountains is excellent; and the air of Madrid, though the weather be variable and uncertain, is extremely pure. It was this purity of the air and excellent quality of the water which induced Philip II. and his ſucceſſors to fix their reſidence in this city. It is alſo well ſupplied with proviſions of all kinds at reaſonable rates; and the court, with the reſort and reſidence of the quality, and the high colleges and offices that are kept here, occaſion a briſk trade and circulation of money.

The ſacred edifices in this city have nothing remarkable in their architecture; thoſe of St Paſqual, St Iſabella, and the Carmelites, contain highly valuable collections of pictures, which may be ſeen with admiration even after the paintings of the Eſcurial and the new palace. The church of St Iſidro, which heretofore belonged to the Jeſuits, has a portal which has eſcaped the contagion of the age in which it was built. There is another church much more modern, which on account of its maſs has a venerable appearance, but which true taſte may juſtly diſavow: it is that of St Saleſas, or the Viſitation, founded by Ferdinand VI. and the queen Barbara his wife.—The convent of St Francis has already been ſome years building *, and there are hopes that it will become one of the fineſt productions of architecture in the capital.—Beſides a variety of charitable foundations, there are here three confraternities, the revenues of which are appropriated to the ſuccour of the wretched; and an inſtitution ſimilar to the *Mont de Pieté* in Paris, the principal object of which is to advance money to the neceſſitous.

* Bourgoanne's Travels in Spain, 1789.

The city of Madrid contains 15 gates, 18 pariſhes, 35 convents of monks, and 31 of nuns; 39 colleges, hoſpitals, or houſes of charity; 7398 dwelling-houſes, and about 160,000 inhabitants. The Lombard traveller, Father Caimo, tells us, that 50,000 ſheep and 12,000 oxen are annually conſumed there; to which his editor has added a ludicrous eſtimate of the onions and leeks devoured there, which he ſays amount to 979000000000000000000000000000045. But this writer (M. Bourgoanne obſerves) would not at preſent have any reaſon to complain of the diſagreeable ſmells of the ſtreets, nor would he find all the perfumes of Arabia neceſſary to defend himſelf from them. By the vigilance of the modern police, for which (M. Bourgoanne informs us) it is indebted to the Count d'Aranda, it is rendered one of the cleaneſt cities in Europe.

There are four academies in Madrid: The firſt is the Spaniſh academy, founded in 1714, in imitation of the French academy, and conſiſting of 24 members, including the preſident. Its device is a crucible on burning coals, with the motto *limpia, fixa, y da eſplender;* "it purifies, fixes, and gives luſtre." Its firſt object was the compilation of a dictionary of the Spaniſh language, which was publiſhed in ſix volumes folio, and of which a new edition, with great additions, has been lately put to the preſs. The ſame academy is alſo employed on a ſuperb edition of Don Quixotte, adorned with elegant engravings far ſuperior to the laſt, and collated with all the former editions. The ſecond is the academy of hiſtory; which owes its origin to a ſociety of individuals, the object of whoſe meetings was to preſerve and illuſtrate the hiſtorical monuments of the kingdom of Spain. Their labours met the approbation of Philip V. who in 1738 confirmed the ſtatutes by a royal cedula. This academy conſiſts of 24 members, including the preſident, ſecretary, and cenſor. Its device is a river at its ſource; and the motto, *In patriam populumque fluit.* The other two academies are, the academy of the fine arts, painting, ſculpture, and architecture; and the academy of medicine. The latter is held in no great eſteem.

The environs of Madrid contain ſeveral royal ſeats; among which are El Buen Retiro, Caſa del Campo, Florida, Le Pardo Sarſuela, and St Ildefonſo; but the moſt magnificent not only in this country but perhaps in the whole world is the Eſcurial, which takes its name from a ſmall village near which it ſtands, about 22 miles north-weſt from Madrid; and of which a deſcription is given under the article ESCURIAL. Another royal palace, greatly admired, particularly for its delicious gardens and ſurpriſing water-works, is Aranjuez, which is ſituated on the Tagus, about 30 miles ſouth of Madrid. See ARANJUEZ.

MADRIGAL, a ſhort amorous poem, compoſed of a number of free and unequal verſes, neither confined to the regularity of a ſonnet, nor to the point of an epigram; but only conſiſting of ſome tender and delicate thought, expreſſed with a beautiful, noble, and elegant ſimplicity.

Menage derives the word from *mandra*, which in Latin and Greek, ſignifies "a ſheep-fold;" imagining it it to have been originally a kind of paſtoral or ſhepherd's ſong; whence the Italians formed their *madrigale*, and we *madrigal*. Others rather chooſe to derive it from the word *madrugar*, which in the Spaniſh language ſignifies "to riſe in the morning;" the *madrigales* being formerly ſung early in the morning by thoſe who had a mind to ſerenade their miſtreſſes.

MADURA, a province of Aſia, in the peninſula on this ſide the Ganges; bounded on the eaſt by Tanjour and Marava, on the ſouth-eaſt by the ſea, on the weſt by the Balagate mountains, which ſeparate it from Malabar, and on the north by Viſiapour and Carnate. The inhabitants are Gentoos, and of a thieviſh diſpoſition. The commodities are rice, elephants teeth, and cotton cloth; of which laſt a great deal is made here, and very fine. The Dutch have a pearl fiſhery, which brings them in a large ſum annually.

MÆANDER, in *Ancient Geography*, a celebrated river of Aſia Minor, riſing near Celænæ. It flows through Caria and Ionia into the Ægean ſea between Miletus and Priene, after it has been increaſed by the waters of the Marſyas, Lycus Eudon, Lethæus, &c. It is celebrated among the poets for its windings, which amount to not leſs than 600, and from which all obliquities have received the name of *mæanders*. It forms in its courſe, according to the obſervation of ſome travellers, the Greek letters ε ζ ξ ς & ω; and from its windings Dædalus is ſaid to have had the firſt idea of his famous labyrinth.

MÆATÆ, anciently a people of Britain, near Severus's wall, inhabiting the diſtrict now called *Lauderdale*, in Scotland.

MÆCENAS, Caius Cilnius, the great friend and counſellor of Auguſtus Cæſar, was himſelf a very polite ſcholar, but is chiefly memorable for having been the patron and protector of men of letters. He was deſcended from a moſt ancient and illuſtrious origin, even from the kings of Hetruria, as Horace often tells us; but his immediate forefathers were only of the equeſtrian order. He is ſuppoſed to have been born at Rome, becauſe his family lived there; but in what year, antiquity does not tell us. It ſays as little about his education; but we know it muſt have been of the moſt liberal kind, and perfectly agreeable to the dignity and ſplendour of his birth, ſince he excelled in every thing that related to arms, politics, and letters. How Mæcenas ſpent his younger years is alſo unknown to us, any farther than by effects; there being no mention made of him by any writer before the death of Julius Cæſar, which happened in the year of Rome 709. Then Octavius Cæſar, who was afterwards called *Auguſtus*, went to Rome, to take poſſeſſion of his uncle's inheritance; and then Mæcenas became firſt publicly known, though he appears to have been Auguſtus's intimate friend, and as it ſhould ſeem guardian, from his childhood. From that time he accompanied him through all his fortunes, and was his counſellor and adviſer upon all occaſions; ſo that Pædo Albinovanus juſtly called him *Cæſaris dextram*, "Cæſar's right-hand."

In A. R. 710, the year that Cicero was killed and Ovid born, Mæcenas diſtinguiſhed himſelf by his courage and military ſkill at the battle of Modena, where the conſuls Hirtius and Panſa were ſlain in fighting againſt Antony; as he did afterwards at Philippi. After this laſt battle began the memorable friendſhip between Mæcenas and Horace. Horace, as Suetonius relates, was a tribune in the army of Brutus and Caſſius, and upon the defeat of thoſe generals made a priſoner of war. Mæcenas, finding him an accompliſhed man, became immediately his friend and protector; and afterwards recommended him to Auguſtus, who reſtored to him his eſtate with no ſmall additions. In the mean time, though Mæcenas behaved himſelf well as a ſoldier in theſe and other battles, yet his principal province was that of a miniſter and counſellor. He was the adviſer, the manager, the negociator, in every thing that related to civil affairs. When the league was made at Brunduſium between Antony and Auguſtus, Mæcenas was ſent to act on the part of Auguſtus. This we learn from Horace in his journey to Brunduſium:

Huc venturus erat Mæcenas optimus, atque
Cocceius, miſſi magnis de rebus uterque
Legati, averſos ſoliti componere amicos. Sat. v. lib. I.

And afterwards, when this league was near breaking, through the ſuſpicions of each party, Mæcenas was ſent to Antony to ratify it anew.

In the year 717, when Auguſtus and Agrippa went to Sicily to fight Sextus Pompeius by ſea, Mæcenas went with them; but ſoon after returned, to appeaſe ſome commotions which were riſing at Rome: for though he uſually attended Auguſtus in all his military expeditions, yet whenever there was any thing to be done at Rome either with the ſenate or people, he was always deſpatched thither for that purpoſe.

Upon the total defeat of Antony at Actium, Mæcenas returned to Rome, to take the government into his hands, till Auguſtus could ſettle ſome neceſſary affairs in Greece and Aſia. Agrippa ſoon followed Mæcenas; and when Auguſtus arrived, he placed theſe two great men and faithful adherents, the one over his civil, the other over his military concerns. While Auguſtus was extinguiſhing the remains of the civil war in Aſia and Egypt, young Lepidus, the ſon of the triumvir, was forming a ſcheme to aſſaſſinate him at his return to Rome. This conſpiracy was diſcovered at once, by the extraordinary vigilance of Mæcenas; who, as Velleius Paterculus ſays, "obſerving the raſh councils of the headſtrong youth with the ſame tranquillity and calmneſs as if nothing at all had been doing, inſtantly put him to death, without the leaſt noiſe and tumult; and by that means extinguiſhed another civil war in its very beginning."

The civil wars being now at an end, Auguſtus returned to Rome; and from this time Mæcenas indulged himſelf at vacant hours in literary amuſements, and the converſation of men of letters. In the year 734 Virgil died, and left Auguſtus and Mæcenas heirs to what he had. Mæcenas was exceſſively fond of this poet, who, of all the wits of the Auguſtan age, ſtood higheſt in his eſteem; and if the Georgics and the Æneid be owing to the good taſte and encouragement of this patron, as there is ſome reaſon to think, poſterity cannot commemorate him with too much gratitude. Horace may be ranked next to Virgil in Mæcenas's good graces: we have already mentioned how and at what time their friendſhip commenced. Propertius alſo acknowledges Mæcenas for his favourer and protector, lib. ii. eleg. 7.

Nor

Mæcenas. Nor muſt Varius be forgot, though we have nothing of his remaining; ſince we find him highly praiſed by both Virgil and Horace. He was a writer of tragedies; and Quintilian thinks he may be compared with any of the ancients. In a word, Mæcenas's houſe was a place of refuge and welcome to all the learned of his time; not only to Virgil, Horace, Propertius, and Varius, but to Fundarius, whom Horace extols as an admirable writer of comedies: to Fuſcus Ariſtius, a noble grammarian, and Horace's intimate friend: to Plotius Tucea, who aſſiſted Varius in correcting the Æneid after the death of Virgil; to Valgius, a poet and very learned man, who, as Pliny tells us, dedicated a book to Auguſtus, *De uſu Herbarum;* to Aſinius Pollio, an excellent tragic writer; and to ſeveral others, whom it would be tedious to mention. All theſe dedicated their works, or ſome part of them at leaſt, to Mæcenas, and celebrated his praiſes in them over and over: and we may obſerve farther, what Plutarch tells us, that even Auguſtus himſelf inſcribed his Commentaries to him and to Agrippa.

Mæcenas continued in Auguſtus's favour to the end of his life, but not uninterruptedly. Auguſtus had an intrigue with Mæcenas's wife: and though the miniſter bore this liberty of his maſter very patiently, yet there was a coldneſs on the part of Auguſtus, which, however, ſoon went off. Mæcenas died in the year 745; but at what age we cannot preciſely determine, though we know he muſt have been old. He muſt have been older than Auguſtus, becauſe he was a kind of tutor to him in his youth: and then find him often called *an old man* by Pædo Albinovanus, a cotemporary poet, whoſe elegy upon his dead patron is ſtill extant. He made Auguſtus his heir; and recommended his friend Horace to him in thoſe memorable laſt words, "*Horatii Flacci, ut mei, memor eſto,*" &c. Horace, however, did not probably ſurvive him long, as there is no elegy of his upon Mæcenas extant, nor any account of one having ever been written, which there certainly would have been had Horace ſurvived him any time. Nay, Father Sanadon, the French editor of Horace, will have it, that the poet died before his patron; and that theſe laſt words were found only in Mæcenas's will, which had not been altered.

Mæcenas is ſaid never to have enjoyed a good ſtate of health in any part of his life: and many ſingularities are related of his bodily conſtitution. Thus Pliny tells us, that he was always in a fever; and that, for three years before his death, he had not a moment's ſleep. Though he was certainly an extraordinary man, and poſſeſſed many admirable virtues and qualities, yet it is agreed on all hands, that he was very luxurious and effeminate. "Mæcenas (ſays Velleius Paterculus) was of the equeſtrian order, but ſprung from a moſt illuſtrious origin. He was a man, who, when buſineſs required, was able to undergo any fatigue and watching; who conſulted properly upon all occaſions, and knew as well how to execute what he had conſulted; yet a man who in ſeaſons of leiſure was luxurious, ſoft, and effeminate, almoſt beyond a woman. He was no leſs dear to Cæſar than Agrippa, but diſtinguiſhed by him with fewer honours; for he always continued of the equeſtrian rank, in which he was born: not that he could not have been advanced upon the leaſt intimation, but he never ſolicited it."

But let moraliſts and politicians determine of Mæcenas as they pleaſe, the men of letters are under high obligations to celebrate his praiſes and revere his memory: for he countenanced, protected, and ſupported, as far as they wanted his ſupport, all the wits and learned men of his time; and that, too, out of a pure and diſintereſted love of letters, when he had no little views of policy to ſerve by their means: whence it is no wonder, that all the protectors and patrons of learning, ever ſince, have uſually been called *Mæcenas's*.

Maelſtrom. MAELSTROM, a very dangerous whirlpool on the coaſt of Norway, in the 68th degree of latitude, in the province of Nordland, and the diſtrict of Lofoden, and near the iſland of Moſkoe, from whence it alſo takes the name of *Moſkoe ſtrom.* Its violence and roarings exceed that of a cataract, being heard to a great diſtance, and without any intermiſſion, except a quarter every ſixth hour, that is, at the turn of high and low water, when its impetuoſity ſeems at a ſtand, which ſhort interval is the only time the fiſhermen can venture in; but this motion ſoon returns, and, however calm the ſea may be, gradually increaſes with ſuch a draught and vortex, as abſorb whatever comes within their ſphere of action, and keep it under water for ſome hours, when the fragments, ſhivered by the rocks, appear again. This circumſtance, among others, makes ſtrongly againſt Kircher and others, who imagine that there is here an abyſs penetrating the globe, and iſſuing in ſome very remote parts, which Kircher is ſo particular as to aſſign, for he names the gulf of Bothnia. But after the moſt exact reſearches which the circumſtances will admit, this is but a conjecture without foundation; for this and three other vortices among the Ferroe iſlands, but ſmaller, have no other cauſe than the colliſion of waves riſing and falling, at the flux and reflux, againſt a ridge of rocks and ſhelves, which confine the water ſo that it precipitates itſelf like a cataract; and thus the higher the flood riſes, the deeper muſt the fall be; and the natural reſult of this is a whirlpool or vortex, the prodigious ſuction whereof is ſufficiently known by leſſer experiments. But what has been thus abſorbed, remains no longer at the bottom than the ebb laſts; for the ſuction then ceaſes, and the flood removes all attraction, and permits whatever had been ſunk to make its appearance again. Of the ſituation of this amazing Moſkoe-ſtrom we have the following account from Mr Jonas Ramus: "The mountain of Helſeggen, in Lofoden, lies a league from the iſland Ver, and betwixt theſe two runs that large and dreadful ſtream called *Moſkoe-ſtrom,* from the iſland Moſkoe, which is in the middle of it, together with ſeveral circumjacent iſles, as Ambaaren, half a quarter of a league northward, Iſleſen, Hoeholm, Kieldholm, Suarven, and Buckholm. Moſkoe lies about half a quarter of a mile ſouth of the iſland of Ver, and betwixt them theſe ſmall iſlands, Otterholm, Flimen, Sanfleſen, Stockholm. Betwixt Lofoden and Moſkoe, the depth of the water is between 36 and 40 fathoms; but on the other ſide, towards Ver, the depth decreaſes, ſo as not to afford a convenient paſſage for a veſſel, without the riſk of ſplitting on the rocks, which happens even in the calmeſt weather: when it is flood, the ſtream runs up the country between Lofoden and Moſkoe with a boiſterous rapidity: but the roar of its impetuous ebb to to the sea is scarcely equalled by the loudest and most dreadful cataracts; the noise being heard several leagues off, and the vortices or pits are of such an extent and depth, that if a ship comes within its attraction, it is inevitably absorbed and carried down to the bottom, and there beat to pieces against the rocks; and when the water relaxes, the fragments thereof are thrown up again. But these intervals of tranquillity are only at the turn of the ebb and flood, and calm weather: and last but a quarter of an hour, its violence gradually returning. When the stream is most boisterous, and its fury heightened by a storm, it is dangerous to come within a Norway mile of it: boats, ships, and yachts having been carried away, by not guarding against it before they were within its reach. It likewise happens frequently, that whales come too near the stream, and are overpowered by its violence; and then it is impossible to describe their howlings and bellowings in their fruitless struggles to disengage themselves. A bear once attempting to swim from Lofoden to Moskoe, with a design of preying upon the sheep at pasture in the island, afforded the like spectacle to the people; the stream caught him, and bore him down, whilst he roared terribly, so as to be heard on shore. Large stocks of firs and pine trees, after being absorbed by the current, rise again, broken and torn to such a degree as if bristles grew on them. This plainly shows the bottom to consist of craggy rocks, among which they are whirled to and fro. This stream is regulated by the flux and reflux of the sea; it being constantly high and low water every six hours. In the year 1645, early in the morning of Sexagesima Sunday, it raged with such noise and impetuosity, that on the island of Moskoe, the very stones of the houses fell to the ground."

MÆMACTERIA, sacrifices offered to Jupiter at Athens in the winter month Mæmacterion. The god surnamed Mæmactes was entreated to send mild and temperate weather, as he presided over the seasons, and was the god of the air.

MÆMACTERION, was the fourth month of the Athenian year, containing twenty-nine days, and answering to the latter part of our September, and the beginning of October. It received its name from the festival *Mæmacteria*, which was observed about this time. This month was called by the Bœotians *Alalcomenius*.

MÆNA. See SPARUS, ICHTHYOLOGY *Index*.

MÆNALUS, in *Ancient Geography*, a mountain of Arcadia sacred to the god Pan, and greatly frequented by shepherds. It received its name from Mænalus a son of Lycaon. It was covered with pine trees, whose echo and shade have been greatly celebrated by all the ancient poets.

MÆONIA, or MOEONIA, a country of Asia Minor, and forming part of Lydia; namely the neighbourhood of Mount Tmolus, and the country watered by the Pactolus. The rest on the sea coast was called Lydia. See LYDIA.

MÆONIDÆ, a name given to the muses, because Homer, their greatest and worthiest favourite, was supposed to be a native of Mæonia.

MÆONIDES, a surname of Homer, because, according to the opinion of some writers, he was born in Mæonia, or because his father's name was Mæon.

MÆOTIS PALUS OR LACUS, *Mæotica Palus*, or *Mæoticus Lacus*, in *Ancient Geography*, a large lake or part of the sea between Europe and Asia, at the north of the Euxine, to which it communicates by the Cimmerian Bosphorus. It was worshipped as a deity by the Massagetæ. It extends about 390 miles from south-west to north-east, and is about 600 miles in circumference. Still called *Palus Mæotis*, reaching from Crim Tartary to the mouth of the Don.

MÆSTLIN, MICHAEL, in Latin *Mæstlinus*, a celebrated astronomer of Germany, was born in the duchy of Wittemberg; but spent his youth in Italy, where he made a speech in favour of Copernicus's system, which brought Galilæo over from Aristotle and Ptolemy, to whom he had been hitherto entirely devoted. He afterwards returned to Germany, and became professor of mathematics at Tubingen; where, among his other scholars, he taught the great Kepler, who has praised several of his ingenious inventions, in his *Astronomia Optica*. Though Tycho Brahé did not assent to Mæstlin's opinion, yet he allowed him to be an extraordinary person, deeply skilled in the science of astronomy. Mæstlin published many mathematical and astronomical works; and died in 1590.

MAESTRICHT, an ancient, large, and strong town of the Netherlands, ceded to the Dutch by the treaty of Munster. The townhouse and the other public buildings are handsome, and the place is about four miles in circumference, and strongly fortified. It is governed jointly by the Dutch and the bishop of Liege; however, it has a Dutch garrison. The inhabitants are noted for making excellent fire arms, and some say that in the arsenal there are arms sufficient for a whole army. Both Papists and Protestants are allowed the free exercise of their religion, and the magistrates are composed of both. It is seated on the river Maese, which separates it from Wyck, and with which it communicates by a handsome bridge. Maestricht revolted from the Spaniards in 1570, but was reduced in 1579. Louis XIV. became master of it in 1673; but it was restored to the states by the treaty of Nimeguen in 1678. It was again taken by the French in 1794. E. Long. 5. 50. N. Lat. 51. 5.

MAFFÆUS, VEGIO, a Latin poet, born in Lombardy in 1407, was greatly admired in his time. He wrote epigrams, and a humorous supplement to Virgil, which he called *The thirteenth book of the Æneid*: this was as humorously translated into English a few years since by Mr Ellis. Maffæus wrote also some prose works. He was chancellor of Rome towards the end of the pontificate of Martin V.; and died in 1458.

MAFFEI, SCIPIO, a celebrated Italian poet, born of an illustrious and ancient family at Verona, in 1675. After having finished his studies, he took arms, and distinguished himself by his valour at the battle of Donawert; but he more particularly distinguished himself by his love of learning, which made him undertake several voyages into France, England, and Germany. He conversed with the learned in all those countries, and obtained their friendship and esteem. He was a member of the academy of the Arcadia at Rome, an honorary foreign member of that of Inscriptions at Paris; and died in 1755. He wrote many works in verse and prose, which are esteemed; the most known of which are, 1. The tragedy of Merope, of which there

Magada || Magazine.

there are two French translations in prose. 2. Ceremony, a comedy. 3. A translation, into Italian verse, of the first book of Homer's Iliad. 4. Many other pieces of poetry, in a collection entitled *Rhyme and Prose*, quarto. His principal works in prose are, 1. *Verona illustrata.* 2. *Istoria diplomatica.* 3. *Scienza cavalleresca;* an excellent work, in which he attacks duelling. 4. An edition of *Theatro Italiano.* 5. An edition of Cassiodorus on the Epistles, Acts of the Apostles, and Apocalypse. 6. *Galliæ Antiquitates quædam selectæ atque in plures epistolas distributæ;* and several other works.

MAGADA, in *Mythology*, a title under which Venus was known and worshipped in Lower Saxony; where this goddess had a famous temple, which was treated with respect even by the Huns and Vandals when they ravaged the country. It is said to have been destroyed by Charlemagne.

MAGADOXO, the capital town of a kingdom of the same name, in Africa, and on the coast of Ajan. It is seated near the mouth of a river of the same name, defended by a citadel, and has a good harbour. The inhabitants are Mahometans. E. Long. 45. 15. N. Lat. 3. 0.

MAGAS, MAGADIS, (from μαγαδιζειν, "to sing or play in unison or octave,") the name of a musical instrument in use among the ancients."

There were two kinds of *magades*, the one a string instrument, formed of 20 chords arranged in pairs, and tuned to unison or octave, so that they yielded ten sounds; the invention whereof is ascribed by some to Sappho; by others, to the Lydians; and by some, to Timotheus of Miletus. The other was a kind of flute, which at the same time yielded very high and very low notes. The former kind was at least much improved by Timotheus of Miletus, who is said to have been impeached of a crime, because by increasing the number of chords he spoiled and discredited the ancient music.

MAGAZINE, a place in which stores are kept, of arms, ammunition, provisions, &c. Every fortified town ought to be furnished with a large magazine, which should contain stores of all kinds, sufficient to enable the garrison and inhabitants to hold out a long siege; and in which smiths, carpenters, wheelwrights, &c. may be employed in making every thing belonging to the artillery; as carriages, waggons, &c.

Powder MAGAZINE, is that place where the powder is kept in very large quantities. Authors differ greatly both with regard to their situation and construction; but all agree that they ought to be arched and bombproof. In fortifications, they are frequently placed in the rampart; but of late they have been built in different parts of the town. The first powder magazines were made with Gothic arches: but M. Vauban finding them too weak, constructed them in a semicircular form; whose dimensionsare 60 feet long within, and 25 broad; the foundations are eight or nine feet thick, and eight feet high from the foundation to the spring of the arch; the floor is two feet from the ground, which keeps it from dampness.

One of our engineers of great experience some time since had observed, that after the centres of semicircular arches are struck, they settle at thec rown and rise up at the hanches, even with a straight horizontal extrados, and still much more so in powder magazines, whose outside at top is formed like the roof of a house, by two inclined planes joining in an angle over the top of the arch, to give a proper descent to the rain; which effects are exactly what might be expected agreeable to the true theory of arches. Now, as this shrinking of the arches must be attended with very ill consequences, by breaking the texture of the cement after it has been in some degree dried, and also by opening the joints of the voussoirs at one end, so a remedy is provided for this inconvenience with regard to bridges, by the *arch of equilibration* in Mr Hutton's book on bridges; but as the ill effect is much greater in powder magazines, the same ingenious gentleman proposed to find an arch of equilibration for them also, and to construct it when the span is 20 feet, the pitch or height 10 (which are the same dimensions as the semicircle), the inclined exterior walls at top forming an angle of 113 degrees, and the height of their angular point above the top of the arch equal to seven feet. This very curious question was answered in 1775 by the reverend Mr Wildbore, to be found in Mr Hutton's *Miscellanea Mathematica*.

Artillery MAGAZINE. In a siege, the magazine is made about 25 or 30 yards behind the battery, towards the parallels, and at least three feet under ground, to hold the powder, loaded shells, portfires, &c. Its sides and roof must be well secured with boards to prevent the earth from falling in: a door is made to it, and a double trench or passage is sunk from the magazine to the battery, one to go in and the other to come out at, to prevent confusion. Sometimes traverses are made in the passages to prevent ricochet shot from plunging into them.

MAGAZINE, on shipboard, a close room or storehouse, built in the fore or after-part of the hold, to contain the gunpowder used in battle. This apartment is strongly secured against fire, and no person is allowed to enter it with a lamp or candle: it is therefore lighted, as occasion requires, by means of the candles or lamps in the *light-room* contiguous to it.

MAGAZINE Air-Gun. See *AIR-GUN*.

MAGAZINES, Literary; a well-known species of periodical publications, of which the first that appeared was *The Gentleman's*, set on foot by the projector Mr Edward Cave in the year 1731: (see the article CAVE). This, as Dr Kippis observes *, "may be considered as something of an epocha in the literary history of this country. The periodical performances before that time were almost wholly confined to political transactions, and to foreign and domestic occurrences; but the monthly magazines have opened a way for every kind of inquiry and information. The intelligence and discussion contained in them are very extensive and various: and they have been the means of diffusing a general habit of reading through the nation, which in a certain degree hath enlarged the public understanding. Many young authors, who have afterwards risen to considerable eminence in the literary world, have here made their first attempts in composition. Here too are preserved a multitude of curious and useful hints, observations, and facts, which otherwise might have never appeared; or if they had appeared in a more evanescent form, would have incurred the danger of being lost. If it

* *Biog. Brit.* vol. iii. Art. CAVE.

it were not an invidious taſk, the hiſtory of them would be no incurious or unentertaining ſubject. The magazines that unite utility with entertainment, are undoubtedly preferable to thoſe *(if there have been any ſuch)* which have only a view to idle and frivolous amuſement. It may be obſerved, that two of them, *The Gentleman's* and *The London*, which laſt was begun the year after the former, have amidſt their numerous rivals preſerved their reputation to the preſent day. They have both of them, in general, joined inſtruction with pleaſure; and this likewiſe hath been the caſe with ſome others of a latter origin."—The original London Magazine, it is believed, has been diſcontinued for ſome years paſt.—The next oldeſt publication of this kind is that entitled *The Scots Magazine;* which was commenced at Edinburgh a few years poſterior to the appearance of the *Gentleman's* at London; which, like it, has ſurvived many rivals; and which ſtill ſubſiſts, deſervedly eſteemed for the chaſteneſs of its plan and the accuracy of its information.

MAGDALEN, Mary. See Mary.

Religious of St Magdalen, a denomination given to divers communities of nuns, conſiſting generally of penitent courtezans; ſometimes alſo called *Magdalenettes*. Such are thoſe at Metz, eſtabliſhed in 1452; thoſe at Paris, in 1492; thoſe at Naples, firſt eſtabliſhed in 1324, and endowed by Queen Sancha, to ſerve as a retreat for public courtezans, who ſhould betake themſelves to repentance; and thoſe of Rouen and Bourdeaux, which had their original among thoſe of Paris in 1618. In each of theſe monaſteries there are three kinds of perſons and congregations; the firſt conſiſt of thoſe who are admitted to make vows, and theſe bear the name of *St Magdalen;* the congregation of St Martha is the ſecond, and is compoſed of thoſe whom it is not judged proper to admit to vows; finally, the congregation of St Lazarus is compoſed of ſuch as are detained there by force.

The religious of St Magdalen at Rome were eſtabliſhed by Pope Leo X. Clement VIII. ſettled a revenue on them; and farther appointed, that the effects of all public proſtitutes, dying inteſtate, ſhould fall to them; and that the teſtaments of the reſt ſhould be invalid unleſs they bequeathed a portion of their effects, which was to be at leaſt a fifth part, to them.

Magdalen Hoſpital. See London, N° 115.

MAGDALENA, one of the Marqueſas iſlands, about five leagues in circuit, and ſuppoſed to be in S. Lat. 10. 25. W. Long. 138. 50. It was only ſeen at nine leagues diſtance by thoſe who diſcovered it.

MAGDALENE's Cave, a cave of Germany, and in Carinthia, 10 miles eaſt of Gortz. It appears like a chaſm in a rock, and at the entrance torches are lighted to conduct travellers. It is divided into ſeveral apartments, or halls, with a vaſt number of pillars formed by nature, which give it a beautiful appearance, they being as white as ſnow, and almoſt tranſparent. The bottom is of the ſame ſubſtance, inſomuch that a perſon may fancy himſelf to be walking among the ruins of an enchanted caſtle, ſurrounded with magnificent pillars, ſome entire and others broken.

MAGDEBURG, a duchy of Germany, in the circle of Lower Saxony; bounded on the north by the duchy of Mecklenburgh, on the ſouth and ſouth-weſt by the principality of Anhalt and Halberſtadt, on the eaſt by Upper Saxony with part of Brandenburg, and on the weſt by the duchy of Wolfenbuttle. The Saale circle, and that of Luxkenwalde, are ſeparated from the reſt, and ſurrounded on all ſides by a part of Upper Saxony. This country is for the moſt part level; but ſandy, marſhy, or overgrown with woods. There are ſalt ſprings in it ſo rich, that they are ſufficient to ſupply all Germany with that commodity. The Holz circle is the moſt fruitful part of it. In the Saale circle, where wood is ſcarce, there is pit-coal: and at Rothenburg is a copper-mine worked. The duchy is well watered, for the Elbe paſſes through it; and the Saale, Havel, Aller, Ohre, and Elſter, either riſe in, or waſh ſome part of it in their courſe. The whole duchy, excluſive of that part of the county of Mansfeldt which is connected with it, is ſaid to contain 29 cities, ſix towns, about 430 villages, and 330,000 inhabitants. The ſtates of the country conſiſt of the clergy, the nobility, and deputies of the cities. Before it became ſubject to the electoral houſe of Brandenburgh, frequent diets were held in it; but at preſent no diets are held, nor have the ſtates the direction of the finances as formerly. Before the Reformation, it was an archbiſhopric, ſubject in ſpirituals to the pope alone, and its prelate was primate of all Germany; but embracing the Reformation, it choſe itſelf adminiſtrators, till the treaty of Munſter in 1648, when it was given, together with the biſhopric of Halberſtadt, to the elector of Brandenburgh, as an equivalent for the Hither Pomerania, granted by that treaty to the king of Sweden. Lutheraniſm is the predominant religion here; but Calviniſts, Jews, and Roman Catholics, are tolerated. Of the laſt there are five convents, who never embraced the Reformation. All the Lutheran pariſhes, amounting to 314, are ſubject to 16 inſpectors, under one general ſuperintendant; only the clergy of the old town of Magdeburg are under the direction of their ſenior. The Jews have a ſynagogue at Halle. The manufactures of the duchy are cloth, ſtuffs, ſtockings, linen, oilſkins, leather, and parchment; of which, and grain of all ſorts, large quantities are exported. The arms of it are, Party per pale, ruby, and pearl. The king of Pruſſia, as duke of Magdeburg, ſits and votes between the elector of Bavaria, as duke of Bavaria, and the elector palatine, as palſgrave of Lautern. Of the ſtates of the circle of Lower Saxony he is the firſt. His matricular aſſeſſment for the duchy is 43 horſe and 196 foot, or 1300 florins monthly; and to the chamber of Wetzlar 343 florins and 40 kruitzers. For the civil government of the duchy there is a council of regency, with a war and demeſne chamber; and for the eccleſiaſtical a conſiſtory and general ſuperintendant. The revenues of the duchy, ariſing from the ſalt-works, demeſne, and taxes, ſome of which are very heavy and oppreſſive, are ſaid to amount to 800,000 rixdollars annually. With reſpect to ſalt, every houſekeeper in the Pruſſian dominion is obliged to buy a certain quantity for himſelf and wife; and alſo for every child and ſervant, horſe, cow, calf, and ſheep, that he poſſeſſes. The principal places are Magdeburg, Halle, and Glauche.

Magdeburg, a city of Germany, in a duchy of the ſame name, of which it is not only the capital, but that of

Magdeburg.

of all Lower Saxony, and formerly even of all Germany. It ſtands on the Elbe, in E. Long. 12. 9. N. Lat. 52. 16. It is a city of great trade, ſtrongly fortified, and very ancient. Its name ſignifies the *maiden city;* which, ſome imagine, took its riſe from the temple of Venus, which is ſaid to have ſtood here anciently, and to have been deſtroyed by Charlemagne. The founder of the city is ſuppoſed to have been Otho I. or his empreſs Editha, daughter to Edmund the Saxon king of England. The ſame emperor founded a Benedictine convent here, which he afterwards converted into an archbiſhopric, of which the archbiſhop was a count-palatine, and had very great privileges, particularly that of wearing the archiepiſcopal pallium, and having the croſs borne before him, beſides many others. The firſt tournament in Germany is ſaid to have been appointed near this city, by the emperor Henry the Fowler; but theſe paſtimes were afterwards aboliſhed, becauſe they occaſioned ſuch envy and animoſity among the nobility, that ſeveral of them killed one another upon the ſpot. The ſituation of the city is very convenient and pleaſant, upon the banks of the Elbe, amidſt ſpacious fruitful plains, and on the road betwixt High and Low Germany. It has been a great ſufferer by fires and ſieges; but by none ſo much as that in 1631 when the emperor's general, Count Tilly, took it by ſtorm, plundered and ſet it on fire, by which it was entirely reduced to aſhes, except the cathedral, the convent of our Lady, and a few cottages belonging to fiſhermen; of 40,000 burghers, not above 400 eſcaping. The ſoldiers ſpared neither age nor ſex; but ripped up women with child, murdered ſucking infants in ſight of their parents, and raviſhed young women in the ſtreets; to prevent which violation, many of them flung themſelves into the Elbe, and others into the fire. The city is now populous, large, and well built, particularly the broad ſtreet and cathedral ſquare. The principal buildings are the king's palace, the governor's houſe, the armoury, guildhall, and cathedral. The laſt is a ſuperb ſtructure in the antique taſte, dedicated to St Maurice, which has a fine organ, the maſter pipe of which is ſo big, that a man can ſcarce claſp it with both arms; it alſo contains the tombs of the emperor Otho and the empreſs Editha; a fine marble ſtatue of St Maurice, a porphyry font, an altar in the choir of one ſtone of divers colours, curiouſly wrought, and many other curioſities. They ſhow here a bedſtead and table which belonged to Martin Luther, when he was an Auguſtine friar in a cloiſter of this city before the Reformation. Among the relics, they pretended to have the baſon in which Pilate waſhed his hands after his condemnation of our Saviour; the lantern which Judas made uſe of when he apprehended him; and the ladder on which the cock crowed after St Peter denied him. The chapter conſiſts of a provoſt, ſixteen major and ſeven minor canons; beſides which, there are four other Lutheran collegiate foundations, and a Lutheran convent dedicated to our Lady, in which is a ſchool or ſeminary. Here is alſo a gymnaſium, with an academy, in which young gentlemen are inſtructed in the art of war. The canons of the chapter, which, except the change of religion, is upon the ſame footing as before the Roformation, muſt make proof of their nobility. The prebends and dignities are all in the gift of the elector; and the revenue of the provoſt is computed at 12,000 crowns a-year. Here is a great trade, and a variety of manufactures. The chief are thoſe of woollen cloths and ſtuffs, ſilks, cottons, linen, ſtockings, hats, gloves, tobacco and ſnuff. The city was formerly one of the Hanſe and Imperial towns. Editha, conſort to Otho I. on whom it was conferred as a dowry, among many other privileges and advantages, procured it the grant of a yearly fair. The burgravate of this city was anciently an office of great power; having the civil and criminal juriſdiction, the office of hereditary cupbearer being annexed to it; and was long held as a fief of the archbiſhopric, but afterwards became an imperial fief, which was again conferred on the archbiſhopric by the elector of Saxony, upon certain conditions.

Magdolum, Magellan.

MAGDOLUM, or MAGDALUM, in *Ancient Geography*, a town of the Lower Egypt, twelve miles to the ſouth of Peluſium (Herodotus, Antonine), which doubtleſs is the Migdol or Magdol of Jeremiah.—Another MAGDALUM, or MIGDOL, denoting literally "a tower or place of ſtrength," near the Red ſea, (Moſes); far to the ſouth of the former.

MAGELLAN, FERDINAND DE, an eminent navigator, was by birth a Portugueſe, of a good family. He ſerved in the Eaſt Indies with reputation for five years under Albuquerque, and in 1510 he greatly diſtinguiſhed himſelf at the battle of Malacca. Deeming his ſervices poorly repaid by his own court, he entered into the employment of Charles V. king of Spain. He has been charged with peculation by ſome of his countrymen, who have aſſigned this as the reaſon why he quitted Portugal. In conjunction with Ruy Folero he formed the bold deſign of diſcovering a new paſſage by the weſt to the Molucca iſlands, which he offered to prove fell within the diviſion of the globe aſſigned by the pope to the crown of Caſtile. It is ſaid that he firſt propoſed this enterprize to Emanuel king of Portugal, who rejected it, as opening a way for other nations to have acceſs to the Eaſt Indies, the trade of which was now monopolized by the Portugueſe. The propoſition was agreed to by the king of Spain, and on the 20th of September 1519 Magellan ſailed from San Lucar with five ſhips and 236 men under his command. His officers ſoon murmured at this appointment, conſidering it as a diſgrace to be commanded by a renegade Portugueſe; and when the fleet was lying at a port in South America which they named San Julian, a conſpiracy was formed againſt him by three of the captains, which he diſcovered and quelled. He cauſed the captain of one of the ſhips to be aſſaſſinated, he boarded a ſecond, and ſecured the mutineers, and the third ſubmitted.

The coaſt on which they lay was that of Patagonia; and this firſt voyage contains accounts of the extraordinary ſtature of the natives. About the end of October they reached a cape, to which they gave the name of Dee las Virgines, forming the entrance of the ſtraits which bear the name of Magellan. He exerted all his authority to induce his men to venture on this unknown paſſage, with the view of croſſing a vaſt ocean beyond it, at the hazard of running ſhort of proviſions, of which a ſupply for three months was all he had remaining. One of his ſhips abandoned him, and made the beſt of her way to Europe. The reſt proceeded, and on the

27th of November they discovered the South sea, which made Magellan shed tears of joy. They continued their voyage over this ocean, now visited for the first time by Europeans, and were not long in suffering those evils from famine which they had apprehended. The men were reduced to the necessity of eating the hides with which the rigging was covered. The weather proved so uniformly calm and temperate, that they gave to the ocean the name of *Pacific.* They came in sight of the Ladrones on the 6th of March, so called from the thievish disposition of the inhabitants; and from thence they sailed to the Philippines. At Zebu Magellan obtained with little difficulty the conversion of the king; and on condition of his becoming a vassal of Spain, the Portuguese assisted him in reducing some neighbouring chieftains, and the cross was erected over some burnt villages.

With about 50 men Magellan landed upon Matan, whose chief refused to submit to Zebu, and an engagement between them lasted for the greater part of the day. His troops having spent all their ammunition, found it necessary to retreat, during which Magellan was wounded in the leg by an arrow, beaten down, and at last slain with a lance. This happened in 1521. By this act of imprudence he lost the honour of being the first circumnavigator of the globe, which fell to the lot of Cano, who brought his ship home by the East Indies. Yet Magellan has secured an immortal name among maritime discoverers, by the commencement of this great enterprize, in which he displayed extraordinary skill and resolution, but disregarded justice and humanity, then almost universal among adventurers of this class.

Straits of Magellan, a narrow passage between the island of Terra del Fuego and the southern extremity of the continent of America. This passage was first discovered by Ferdinand Magellan, who sailed through it into the South sea, and from thence to the East Indies. Other navigators have passed the same way; but as these straits are exceedingly difficult, and subject to storms, it has been common to sail by Cape Horn, rather than through the straits of Magellan. See *Straits Le Maire*, and *Terra del Fuego*.

MAGELLANIC clouds, whitish appearances like clouds, seen in the heavens towards the south pole, and having the same apparent motion as the stars. They are three in number, two of them near each other. The largest lies far from the south pole; but the other two are not many degrees more remote from it than the nearest conspicuous star, that is, about 11 degrees. Mr Boyle conjectures, that if these clouds were seen through a good telescope, they would appear to be multitudes of small stars, like the milky-way.

MAGGI, Jerome, in Latin *Magius*, one of the most learned men of the 16th century, was born at Anghiari in Tuscany. He applied himself to all the sciences, and even to the art of war; and distinguished himself so much in this last study, that the Venetians sent him into the island of Cyprus in quality of judge of the admiralty. When the Turks besieged Famagusta, he performed all the services that could be expected from the most excellent engineer: he invented mines and machines for throwing fire, by means of which he destroyed all the works of the besiegers, and in an instant overthrew what had cost the Turks infinite labour. But they had their revenge; for, taking the city in 1571, they plundered his library, carried him loaded with chains to Constantinople, and treated him in the most inhuman and barbarous manner. He nevertheless comforted himself from the example of Æsop, Menippus, Epictetus, and other learned men; and, after passing the whole day in the meanest drudgery, he spent the night in writing. He composed, by the help of his memory alone, treatises filled with quotations, which he dedicated to the Imperial and French ambassadors. These ministers, moved by compassion for this learned man, resolved to purchase him; but while they were treating for his ransom, Maggi found means to make his escape, and to get to the Imperial ambassador's house; when the grand visir being enraged at his flight, and remembering the great mischief he had done the Turks during the siege of Famagusta, sent to have him seized, and caused him to be strangled in prison in 1572. His principal works are, 1. A Treatise on the Bells of the Ancients. 2. On the Destruction of the World by Fire. 3. Commentaries on Æmilius Probus's Lives of Illustrious Men. 4. Commentaries on the Institutes. These works are written in elegant Latin. He also wrote a treatise on fortification in Italian; and a book on the situation of ancient Tuscany.

He ought not to be confounded with his brother *Bartholomew Maggi*, a physician at Bologna, who wrote a treatise of gunshot wounds: nor with *Vincent Maggi*, a native of Bresse, and a celebrated professor of humanity at Ferrara in Padua, who was the author of several works.

MAGGOT, the common name of the fly-worm bred in flesh, from the egg of the great blue flesh fly. Notwithstanding the distaste for this animal, its figure and structure of parts are greatly worth attending to; and may serve as a general history of the class of worms produced from the eggs of flies.

This animal is white and fleshy; its body is composed of a number of rings, like the bodies of caterpillars and other similar insects; and is capable, at the pleasure of the animal, of assuming different figures; being at times more or less extended in length, and consequently more or less thick.

Notwithstanding that this animal has no legs, it is able to move itself very swiftly; and in its first attempt to move its body, is extended to its greatest length, and assumes something of the figure of a pointed cone. The pointed part of the cone is the head of the animal, and is not separated from the next ring by any deeper furrow than the rest of the rings are from one another. In some states of the animal, one may see two short horns thrust out from the head; but more generally two scaly hooks are observable: these are, however, sometimes hid, and have each of them a case or sheath; into which the animal can retract them at pleasure. These hooks are bent into an arch, the concavity of which is towards the plane on which the creature is placed; and they are thickest at their insertion in the head, and thence diminish gradually, till they terminate in a fine sharp point.

These two hooks are placed in a parallel direction, and can never come together, and therefore cannot serve in the place of teeth for grinding the food; but merely to pull and sever it in pieces, that it may be of a proper ſize for the mouth of the creature. Beſides theſe hooks the maggot has a kind of dart, which is about a third part of their length, and is placed at an equal diſtance between them. This alſo is brown and ſcaly like them; it is quite ſtraight, and terminates in a fine point. The hooks have as it were two ſcaly thorns at their points; and this dart ſeems intended, by reiterated ſtrokes to divide, and break the pieces of fleſh theſe have ſeparated from the reſt into ſmaller parts. Immediately below the apertures for the egreſs of the hooks, is placed the mouth of the animal; the creature does not ſhow this little opening unleſs preſſed: but if the preſſure is properly managed it will ſufficiently open it, and there may be diſcovered within it a ſmall protuberance, which may very naturally be ſuppoſed either the tongue or the ſucker of the animal. The hooks in theſe creatures not only ſupply the place of teeth, but alſo of legs; ſince it is by faſtening theſe hooks into the ſubſtance it is placed on, and then drawing up its body to it, that it pulls itſelf along.

The back of this creature lowers itſelf by degrees as it approaches the extremity of the belly; and near the place where the back begins to lower itſelf, are placed the creature's two principal organs of reſpiration. One may perceive there are two ſmall roundiſh brown ſpots: they are very eaſily diſtinguiſhable by the naked eye, becauſe the reſt of the body of the creature is white; but if we take in the aſſiſtance of glaſſes, each of theſe ſpots appears to be a brown circular eminence raiſed a little above the reſt of the body. On each of theſe ſpots one may alſo diſcover three oblong oval cavities, ſomething of the ſhape of button holes; theſe are ſituated in a parallel direction to one another, and their length nearly in a perpendicular direction to that of the body of the animal. Theſe apertures are ſo many ſtigmata or air-holes; openings deſtined to admit the air neceſſary to the life of the animal. It has ſix of theſe ſtigmata, three in each ſide of its body.

The great tranſparency of the body of this animal gives us an opportunity alſo to diſtinguiſh that it has on each ſide a large white veſſel running the whole length of the body. It is eaſy to follow the courſe of theſe veſſels through their whole length, but they are moſt diſtinct of all towards its hinder part; and they are always ſeen to terminate each in the brown ſpot above mentioned; this leaves us no room to doubt that they are the two principal tracheæ.

The ramifications of the two great tracheæ are very beautifully ſeen in this creature, eſpecially on its belly; and it is remarkable, that no veſſel analogous to the great artery in the caterpillar claſs can be diſcovered in theſe; though, if there were any ſuch, their great tranſparence muſt needs make them very eaſily diſtinguiſhable; nor could its dilatations and contractions, if ſo conſiderable as in that claſs of animals, be leſs ſo. See CATERPILLAR, ENTOMOLOGY *Index*.

Malpighi imagined, that this artery in the caterpillar claſs was a ſeries of hearts; in its place, however, there may be ſeen in theſe animals a true heart. It is eaſy to obſerve in theſe creatures, about the fourth ring of their body, a ſmall fleſhy part, which has alternate contractions and dilatations; and is not only diſcoverable in the body by means of its tranſparence, but on making a proper ſection of them in the ſecond, third, and fourth, will be thrown out of the body of the creature, and continue its beats for ſome time afterwards.

MAGI, or MAGIANS, an ancient religious ſect in Perſia, and other eaſtern countries, who maintained that there were two principles, one the cauſe of all good, the other the cauſe of all evil: and, abominating the adoration of images, they worſhipped God only by fire; which they looked upon as the brighteſt and moſt glorious ſymbol of Oromaſdes, or the good god; as darkneſs is the trueſt ſymbol of Arimanius, or the evil god. This religion was reformed by Zoroaſter, who maintained that there was one ſupreme independent Being; and under him two principles or angels, one the angel of goodneſs and light, and the other of evil and darkneſs; that there is a perpetual ſtruggle between them, which ſhall laſt to the end of the world; that then the angel of darkneſs and his diſciples ſhall go into a world of their own, where they ſhall be puniſhed in everlaſting darkneſs; and the angel of light and his diſciples ſhall alſo go into a world of their own, where they ſhall be rewarded in everlaſting light.

The prieſts of the magi were the moſt ſkilful mathematicians and philoſophers of the ages in which they lived, inſomuch that a learned man and a magian became equivalent terms. The vulgar looked on their knowledge as ſupernatural; and hence thoſe who practiſed wicked and miſchievous arts, taking upon themſelves the name of *magians*, drew on it that ill ſignification which the word magician now bears among us.

This ſect ſtill ſubſiſts in Perſia under the denomination of *gaurs*, where they watch the ſacred fire with the greateſt care, and never ſuffer it to be extinguiſhed.

MAGIC, (MAGIA, Μαγεια), in its ancient ſenſe, the ſcience or diſcipline and doctrine of the magi, or wiſe men of Perſia. See MAGI.

The origin of magic and the magi is aſcribed to Zoroaſter. Salmaſius derives the very name from Zoroaſter, who, he ſays, was ſurnamed *Mog*, whence Magus. Others, inſtead of making him the author of the Perſian philoſophy, make him only the reſtorer and improver thereof; alleging, that many of the Perſian rites in uſe among the magi were borrowed from the Zabii among the Chaldeans, who agreed in many things with the magi of the Perſians; whence ſome make the name *magus* common both to the Chaldeans and Perſians. Thus Plutarch mentions, that Zoroaſter inſtituted magi among the Chaldeans, in imitation whereof the Perſians had theirs too.

MAGIC, in a more modern ſenſe, is a ſcience which teaches to perform wonderful and ſurpriſing effects.

The word *magic* originally carried with it a very innocent, nay, laudable meaning; being uſed purely to ſignify the ſtudy of wiſdom, and the more ſublime parts of knowledge; but in regard the ancient magi engaged themſelves in aſtrology, divination, ſorcery, &c. the term *magic* in time became odious, and was only uſed to ſignify an unlawful and diabolical kind of ſcience, depending on the aſſiſtance of the devil and departed ſouls.

If any wonder how ſo vain and deceitful a ſcience ſhould gain ſo much credit and authority over men's minds, Pliny gives the reaſon of it. It is, ſays he,

becauſe

Magic.

becauſe it has poſſeſſed itſelf of three ſciences of the moſt eſteem among men: taking from each all that is great and marvellous in it. Nobody doubts but it had its firſt origin in medicine; and that it inſinuated itſelf into the minds of the people, under pretence of affording extraordinary remedies. To theſe fine promiſes it added every thing in religion that is pompous and ſplendid, and that appears calculated to blind and captivate mankind. Laſtly, It mingled judicial aſtrology with the reſt; perſuading people, curious of futurity, that it ſaw every thing to come in the heavens. Agrippa divides magic into three kinds; natural, celeſtial, and ceremonial or ſuperſtitious.

Natural Magic is no more than the application of natural active cauſes to paſſive ſubjects; by means whereof many ſurpriſing, but yet natural, effects are produced.

In this way many of our experiments in natural philoſophy, eſpecially thoſe of electricity, optics, and magnetiſm, have a kind of magical appearance, and among the ignorant and credulous might eaſily paſs for miracles. Such, without doubt, have been ſome of thoſe miracles wrought by ancient magicians, whoſe knowledge of the various powers of nature, there is reaſon to believe, was much greater than modern vanity will ſometimes allow †.

† See *Stillingfleet's Origines Sacræ*, book ii. c. 2.

Baptiſta Porta has a treatiſe of natural magic, or of ſecrets for performing very extraordinary things by natural cauſes. The natural magic of the Chaldeans was nothing but the knowledge of the powers of ſimples and minerals. The magic which they called *theurgia*, conſiſted wholly in the knowledge of the ceremonies to be obſerved in the worſhip of the gods, in order to be acceptable. By virtue of theſe ceremonies they believed they could converſe with ſpiritual beings, and cure diſeaſes.

Celeſtial Magic borders nearly on judiciary aſtrology: it attributes to ſpirits a kind of rule or dominion over the planets, and to planets a dominion over men; and on thoſe principles builds a ridiculous kind of ſyſtem. See Astrology.

Superſtitious or *Goetic Magic* conſiſts in the invocation of devils. Its effects are uſually evil and wicked, though very ſtrange, and ſeemingly ſurpaſſing the powers of nature; ſuppoſed to be produced by virtue of ſome compact, either tacit or expreſs, with evil ſpirits: but the truth is, theſe have not all the power that is uſually imagined, nor do they produce thoſe effects ordinarily aſcribed to them.

This ſpecies of magic, there is every reaſon to believe, had its origin in Egypt, the native country of paganiſm. The firſt magicians mentioned in hiſtory were Egyptians; and that people ſo famed for early wiſdom believed not only in the exiſtence of dæmons, the great agents in magic (ſee Dæmon), but alſo that different orders of thoſe ſpirits preſided over the elements of earth, air, fire, and water, as well as over the perſons and affairs of men. Hence they aſcribed every diſeaſe with which they were afflicted to the immediate agency of ſome evil dæmon. When any perſon was ſeized with a fever, for inſtance, they did not think it neceſſary to ſearch for any natural cauſe of the diſeaſe: it was immediately attributed to ſome dæmon which had taken poſſeſſion of the body of the patient, and which could not to be ejected but by charms and incantations.

Theſe ſuperſtitious notions, which had ſpread from Egypt over all the eaſt, the Jews imbibed during their captivity in Babylon. Hence we find them in the writings of the New Teſtament attributing almoſt every diſeaſe to which they were incident to the immediate agency of devils (ſee Possession). Many of the ſame impious ſuperſtitions were brought from Egypt and Chaldea by Pythagoras, and tranſmitted by him and his followers to the Platoniſts in Greece. This is apparent from the writers of the life of Pythagoras. Jamblicus, ſpeaking of the followers of that philoſopher, ſays expreſsly, that they cured certain diſeaſes by incantations; and Porphyry adds, that they cured diſeaſes both of the mind and of the body by ſongs and incantations. This was exactly the practice of the Egyptian prieſts, who were all ſuppoſed to keep up a conſtant intercourſe with dæmons, and to have the power of controuling them by magical charms and ſacred ſongs. Agreeably to this practice of his maſters, we are told that Pythagoras directed certain diſeaſes of the mind, doubtleſs thoſe which he attributed to the agency of dæmons, to be cured partly by *incantations*, partly by *magical hymns*, and partly by *muſic*.—*και τας ψυχας δε νοσουντας παρεμυθειτο τους μεν επωδαις και μαγεικις τους δε μουσικη.*

That there are different orders of created ſpirits, whether called dæmons or angels, whoſe powers intellectual and active greatly ſurpaſs the powers of man, reaſon makes probable, and revelation certain. Now it was the univerſal belief of the ancient nations, ſays the learned Moſheim *, and eſpecially of the orientals, that certain ſounds and words, for the moſt part barbarous, were highly grateful, and that others were equally diſagreeable, to theſe ſpirits. Hence, when they wiſhed to render a dæmon propitious, and to employ him on any particular office, the magicians compoſed their ſacred ſongs of the words which were believed to be agreeable to him; and when it was their intention to drive him from themſelves or others, they ſung in a ſtrain which they fancied a dæmon could not hear but with horror. From the ſame perſuaſion aroſe the cuſtom of ſuſpending from the neck of a ſick perſon, whoſe diſeaſe was ſuppoſed to be inflicted by a dæmon, an amulet, ſometimes made of gold and ſometimes of parchment on which was written one or more of thoſe words which dæmons could not bear either to hear or to ſee: and in a didactic poem on the healing art ſtill extant, we are taught by *Serenus Sammonicus*, that the word Abracadabra is an infallible remedy for a ſemitertian fever or ague; and to baniſh grief of heart, *Marcellinus* thinks nothing more effectual than the word *καριαγκων*. In more modern times, as we are informed by Agrippa, the words uſed by thoſe in compact with the devil, to invoke him, and to ſucceed in what they undertake, are, *Dies*, *mies*, *jeſquet*, *benedoefet*, *douvima*, *enitemaus*. There are a hundred other formulas of words compoſed at pleaſure, or gathered from ſeveral different languages, or patched from the Hebrew or formed in imitation of it. And among the primitive Chriſtians there was a ſuperſtitious cuſtom, of which we ſuſpect ſome remains may yet be found among the illiterate vulgar in different countries,

* See his edition of *Cudworth's Intellectual Syſtem*.

of

of faſtening to the neck of a ſick perſon, or to the bed on which he lay, ſome text from the New Teſtament, and eſpecially the firſt two or three verſes of the goſpel of St John, as a charm undoubtedly efficacious to baniſh the diſeaſe.

That magicians who could thus cure the ſick, were likewiſe believed to have the power of inflicting diſeaſes, and of working miracles, by means of their ſubſervient dæmons, need not be doubted. Ancient writers of good credit are full of the wonders which they performed. We ſhall mention a few of thoſe which are beſt atteſted, and inquire whether they might not have been effected by other means than the interpoſition of dæmons.

The firſt magicians of whom we read are thoſe who in Egypt oppoſed Moſes. And we are told, that, when Aaron caſt down his rod, and it became a ſerpent, they alſo did the like with their enchantments; "for they caſt down every man his rod, and they became ſerpents." This was a phenomenon which, it muſt be confeſſed, had a very miraculous appearance; and yet there ſeems to have been nothing in it which might not have been effected by ſlight of hand. The Egyptians, and perhaps the inhabitants of every country where ſerpents abound, have the art of depriving them of their power to do miſchief, ſo that they may be handled without danger. It was eaſy for the magicians, who were favoured by the court, to pretend that they changed their rods into ſerpents, by dexterouſly ſubſtituting one of thoſe animals in place of the rod. In like manner they might pretend to change water into blood, and to produce frogs; for if Moſes gave in theſe inſtances, as we know he did in others, any previous information of the nature of the miracles which were to be wrought, the magicians might eaſily provide themſelves in a quantity of blood and number of frogs ſufficient to anſwer their purpoſe of deceiving the people. Beyond this, however, their power could not go. It ſtopped where that of all workers in legerdemain muſt have ſtopt—at the failure of proper materials to work with. Egypt abounds with ſerpents; blood could be eaſily procured; and without difficulty they might have frogs from the river: But when Moſes produced lice from the duſt of the ground, the magicians, who had it not in their power to collect a ſufficient quantity of theſe animals, were compelled to own this to be an effect of divine agency.

The appearance of Samuel to Saul at Endor is the next miracle, ſeemingly performed by the power of magic, which we ſhall conſider. It was a common pretence of magicians, that they could raiſe up ghoſts from below, or make dead perſons appear unto them to declare future events; and the manner of their incantation is thus deſcribed by Horace:

—Pallor utraſque
Fecerat horrendas aſpectu. Scalpere terram
Unguibus, et pullam divellere mordicus agnam
Cœperunt: cruor in foſſam confuſus, ut inde
Manes elicerent, animas reſponſa daturas.

"With yellings dire they fill'd the place,
And hideous pale was either's face.
Soon with their nails they ſcrap'd the ground,
And fill'd a magic trench profound
With a black lamb's thick-ſtreaming gore,
Whoſe members with their teeth they tore;
That they might charm the ſprights to tell
Some curious anecdotes from hell." FRANCIS.

Whether the witch of Endor made uſe of ſuch infernal charms as theſe, the ſacred hiſtorian has not informed us; but Saul addreſſed her, as if he believed that by ſome form of incantation ſhe could recal from the ſtate of departed ſpirits the ſoul of the prophet who had been for ſome time dead. In the ſubſequent apparition, however, which was produced, ſome have thought there was nothing more than a trick, by which a cunning woman impoſed upon Saul's credulity, making him believe that ſome confidant of her own was the ghoſt of Samuel. But had that been the caſe, ſhe would undoubtedly have made the pretended Samuel's anſwer as pleaſing to the king as poſſible, both to ſave her own life, which appears from the context to have been in danger, and likewiſe to have procured the larger reward. She would never have told her ſovereign, ſhe durſt not have told him, that he himſelf ſhould be ſhortly ſlain, and his ſons with him; and that the hoſt of Iſrael ſhould be delivered into the hands of the Philiſtines. For this reaſon many critics, both Jewiſh and Chriſtian, have ſuppoſed that the apparition was really a dæmon or evil angel, by whoſe aſſiſtance the woman was accuſtomed to work wonders, and to foretel future events. But it is ſurely very incredible, that one of the apoſtate ſpirits of hell ſhould have upbraided Saul for applying to a *ſorcereſs*, or ſhould have accoſted him in ſuch words as theſe: "Why haſt thou diſquieted *me*, to bring me up? Wherefore doſt thou aſk of *me*, ſeeing the *Lord* is departed from thee, and is become thine enemy! For the *Lord* hath rent the kingdom out of thine hand, and given it to thy neighbour, even to David. Becauſe thou obeyedſt not the voice of the *Lord*, therefore the *Lord* hath done this thing to thee this day." It is to be obſerved farther, that what was here denounced againſt Saul was really prophetic, and that the event anſwered to the prophecy in every particular. Now, though we do not deny that there are created ſpirits of penetration vaſtly ſuperior to that of the moſt enlarged human underſtanding; yet we dare maintain, that no finite intelligence could by its own mere capacity have ever found out the preciſe time of the two armies engaging, the ſucceſs of the Philiſtines, the conſequences of the victory, and the very names of the perſons that were to fall in battle. Saul and his ſons were indeed men of tried bravery, and therefore likely to expoſe themſelves to the greateſt danger: but after the menaces which he received from the apparition, he would have been impelled, one ſhould think, by common prudence, either to chicane with the enemy, or to retire from the field without expoſing himſelf, his ſons, and the whole army, to certain and inevitable deſtruction; and his acting differently, with the conſequences of his conduct, were events which no limited underſtanding could either foreſee or certainly foretel. If to theſe circumſtances we add the ſuddenneſs of Samuel's appearance, with the effect which it had upon the ſorcereſs herſelf, we ſhall find reaſon to believe, that the apparition was that of no evil dæmon. There is not, we believe, upon record, another inſtance of any perſon's ſon's pretending to raiſe a ghoſt from below, without previouſly uſing ſome magical rites or ſome form of incantation. As nothing of that kind is mentioned in the caſe before us, it is probable that Samuel appeared before he was called. It is likewiſe evident from the narrative, that the apparition was not what the woman expected; for we are told, that "when ſhe ſaw Samuel, ſhe cried out for fear." And when the king exhorted her not to be afraid, and aſked what ſhe ſaw, "the woman ſaid, I ſee gods (*elohim*) aſcending out of the earth." Now, had ſhe been accuſtomed to do ſuch feats, and known that what ſhe ſaw was only her ſubſervient dæmon, it is not conceivable that ſhe could have been ſo frightened, or have miſtaken her familiar for *elohim* in any ſenſe in which that word can be taken. We are therefore ſtrongly inclined to adopt the opinion of thoſe who hold that it was Samuel himſelf who appeared and propheſied, not called up by the wretched woman or her dæmons, but, to her utter confuſion, and the diſgrace of her art, ſent by God to rebuke Saul's madneſs in a moſt affecting and mortifying way, and to deter all others from ever applying to magicians or dæmons for aſſiſtance when refuſed comfort from heaven. For though this hypotheſis may to a ſuperficial thinker ſeem to tranſgreſs the rule of Horace—*Nec deus interſit*, &c.—which is as applicable to the interpretation of ſcripture, as to the introduction of ſupernatural agency in human compoſitions; yet he who has ſtudied the theocratical conſtitution of Iſrael, the nature of the office which was there termed regal, and by what means the adminiſtration was in emergencies conducted, will have a different opinion; and at once perceive the *dignus vindice nodus*.

The ſudden and wonderful deſtruction of the army of Brennus the Gaul, has likewiſe been attributed to magic, or, what in this inquiry amounts to the ſame thing, to the interpoſition of evil ſpirits, whom the prieſts of Apollo invoked as gods. Thoſe barbarians had made an inroad into Greece, and inveſted the temple of Apollo at Delphi, with a view to plunder it of the ſacred treaſure. Their numbers and courage overpowered all oppoſition; and they were juſt upon the point of making themſelves maſters of the place, when, Juſtin informs us, that, to encourage the beſieged, the prieſts and propheteſs "adveniſſe deum *clamant;* eumque ſe vidiſſe deſilientem in templum per culminis aperta faſtigia. Dum omnes opem dei ſuppliciter implorant, juvenem ſupra humanum modum inſignis pulchritudinis, comiteſque ei duas armatas virgines, ex propinquis duabus Dianæ Minervæque ædibus occurriſſe, nec oculis tantum hæc ſe perſpexiſſe; audiſſe etiam ſtridorem arcus, ac ſtrepitum armorum: proinde ne cunctarentur, diis anteſignanis, hoſtem cædere, et victoriæ deorum ſocios ſe adjungere," ſummis obſecrationibus monebant. Quibus vocibus incenſi, omnes certatim in prælium proſiliunt. Præſentiam Dei et ipſi ſtatim ſenſere: nam et terræ motu portio montis abrupta Gallorum ſtravit exercitum, et confertiſſimi cunei non ſine vulneribus hoſtium diſſipati ruebant. Inſecuta deinde tempeſtas eſt, quæ grandine et frigore ſaucios ex vulneribus abſumpſit (A).

This was unqueſtionably an extraordinary event: and it muſt be aſcribed either to the immediate interpoſition of the Supreme Being, to natural means, or to the agency of dæmons: there is no other alternative. But it is altogether incredible that the Supreme Being ſhould have miraculouſly interpoſed to defend the temple of a pagan divinity. It is very difficult to ſuppoſe that an earthquake, produced in the ordinary courſe of nature, ſhould have been foretold by the prieſts, or that it could have happened ſo opportunely for the preſervation of their treaſure from the hands of fierce barbarians. Nothing, therefore, it has been ſaid, remains, but either to allow the earthquake to have been produced by evil ſpirits, or to deny the truth of the hiſtorian's relation. But the cataſtrophe of Brennus's army is recorded in the ſame manner by ſo many ancient writers of good credit, that we cannot call in queſtion their veracity; and therefore, being unwilling to admit the agency of dæmons into this affair, it will be incumbent on us to ſhow by what human contrivance it might have been effected; for its arrival at ſo critical a juncture will not eaſily ſuffer us to ſuppoſe it a mere *natural* event.

"The inclination of a Pagan prieſt (ſays Biſhop Warburton †) to aſſiſt his god in extremity, will hardly be queſtioned; and the inclination of thoſe at *Delphi* was not ill ſeconded by their public management and addreſs. On the firſt rumour of Brennus's march againſt them, they iſſued orders, as from the oracle, to all the region round, forbidding the country people to ſecret or bear away their wine and proviſions. The effects of this order ſucceeded to their expectations. The half-ſtarved barbarians finding, on their arrival in *Phocis*, ſo great a plenty of all things, made ſhort marches, diſperſed themſelves over the country, and revelled in the abundance that was provided for them. This reſpite gave time to the friends and allies of the god to come to his aſſiſtance. Their advantages of ſituation likewiſe ſupported the meaſures which they had taken for a vigorous defence. The town and temple of Delphi were ſeated on a bare and cavernous rock, defended on all ſides with precipices inſtead

† *Julian.*

"(A) Called aloud that the god had arrived: That they had ſeen him leap into the temple through the aperture in the roof: That whilſt they were all humbly imploring his help, a youth of more than human beauty, accompanied by two virgins in armour, had run to their aſſiſtance from the neighbouring temples of Diana and Minerva; and that they had not only beheld theſe things with their eyes, but had alſo heard the whizzing of his bow and the clangor of his arms. They therefore earneſtly exhorted the beſieged not to neglect the heavenly ſignal, but to ſally out upon their enemies, and partake with the divinities of the glory of the victory." With theſe words the ſoldiers being animated, eagerly ruſhed to battle: and were themſelves quickly ſenſible of the preſence of the god; for part of the rock being torn away by an earthquake, rolled down upon the Gauls; whoſe thickeſt battalions being thus thrown into confuſion, fled, expoſed to the weapons of their enemies. Soon afterwards a tempeſt aroſe, which by cold and the fall of hailſtones cut off the wounded.

inſtead of walls. A large receſs within aſſumed the form of a theatre; ſo that the ſhouts of ſoldiers, and the ſounds of military inſtruments, re-echoing from rock to rock, and from cavern to cavern, increaſed the clamour to an immenſe degree; which, as the hiſtorian obſerves, could not but have great effects on ignorant and barbarous minds. The playing off theſe panic terrors was not indeed of itſelf ſufficient to repulſe and diſſipate an hoſt of fierce and hungry invaders, but it enabled the defenders to keep them at bay till a more ſolid entertainment was provided for them, in the *exploſion* and fall of that portion of the rock at the foot of which the greater part of the army lay encamped.

"Among the caverns in the ſacred rock, there was one which, from an intoxicating quality diſcovered in the ſteam which iſſued from it, was rendered very famous by being fitted to the recipient of the prieſteſs of Apollo (B). Now, if we only ſuppoſe this, or any other of the vapours emitted from the numerous fiſſures, to be endowed with that unctuous, or otherwiſe inflammatory quality, which modern experience ſhows to be common in mines and ſubterraneous places, we can eaſily conceive how the prieſts of the temple might, without the agency of dæmons, be able to work the wonders which hiſtory ſpeaks of as effected in this tranſaction. For the throwing down a lighted torch or two into a chaſm whence ſuch a vapour iſſued, would ſet the whole into a flame; which by ſuddenly rarefying and dilating the air, would, like fired gunpowder, blow up all before it. That the prieſts, the guardians of the rock, could be long ignorant of ſuch a quality, or that they would divulge it when diſcovered, cannot be ſuppoſed. Strabo relates, that one *Onomarchus*, with his companions, as they were attempting by night to dig their way through to rob the holy treaſury, were frightened from their work by the violent ſhaking of the rock; and he adds, that the ſame phenomenon had defeated many other attempts of the like nature. Now, whether the tapers which *Onomarchus* and his companions were obliged to uſe while they were at work, inflamed the vapour, or whether the prieſts of Apollo heard them at it, and ſet fire to a countermine, it is certain a quality of this kind would always ſtand them in ſtead. Such then (preſumes the learned prelate) was the expedient (C) they employed to diſlodge this neſt of hornets, which had ſettled at the foot of their ſacred rock; for the ſtorm of thunder, lightning, and hail, which followed, was the natural effect of the violent concuſſions given to the air by the exploſion of the mine."

Two inſtances more of the power of ancient magic we ſhall juſt mention, not becauſe there is any thing particular or important in the facts, but becauſe ſome credit ſeems to have been given to the narration by the diſcerning Cudworth. Philoſtratus, in his life of Apollonius Tyanæus, informs us that a *laughing demoniac* at Athens was cured by that magician, who ejected the evil ſpirit by threats and menaces; and the biographer adds, that the dæmon, at his departure, is ſaid to have overturned a ſtatue which ſtood before the porch where the cure was performed. The other inſtance is of the ſame magician freeing the city of Epheſus from the *plague*, by ſtoning to death an old ragged beggar whom Apollonius called the *plague*, and who appeared to be a *dæmon* by his changing himſelf into the form of a *ſhagged dog*.

That ſuch tales as theſe ſhould have been thought worthy of the ſlighteſt notice by the incomparable author of the Intellectual Syſtem, is indeed a wonderful phenomenon in the hiſtory of human nature. The whole ſtory of Apollonius Tyanæus, as is now well known, is nothing better than a collection of the moſt extravagant fables *: but were the narrative ſuch as that credit could be given to the facts here related, there appears no neceſſity in either caſe for calling in the agency of evil ſpirits by the power of magic.— The Athenians of that age were a ſuperſtitious people. Apollonius was a ſhrewd impoſtor, long practiſed in the art of deceiving the multitude. For ſuch a man it was eaſy to perſuade a friend and confidant to act the part of the *laughing demoniac*; and without much difficulty the ſtatue might be ſo undermined as inevitably to tumble, upon a violent concuſſion being given to the ground at the time of the departure of the pretended demon. If ſo, this feat of magic dwindles down into a very trifling trick performed by means both ſimple and natural. The other caſe of the poor man at Epheſus, who was ſtoned to death, is exactly ſimilar to that of thoſe innocent women in our own country, whom the vulgar in the laſt century were inſtigated to burn for the ſuppoſed crime of witchcraft. We have no reaſon to ſuppoſe that an Epheſian mob was leſs inflammable or credulous than a Britiſh mob, or that Apollonius played his part with leſs ſkill than a Chriſtian demonologiſt; and as the ſpirits of our witches, who were ſacrificed to folly and fanaticiſm, were often ſuppoſed to migrate from their dead bodies into the bodies of *hares* or *cats* accidentally paſſing by, ſo might this impoſtor at Epheſus perſuade his cruel and credulous inſtruments, that the ſpirit of their victim had taken poſſeſſion of the body of the *ſhagged dog*.

* See *Prideaux's Connexions*, *Brucker's Hiſtory of Philoſophy*, and *Moſheim's Notes on Cudworth's Intellectual Syſtem*.

Still it may be ſaid, that in *magic* and *divination* events have been produced out of the ordinary courſe of nature; and as we cannot ſuppoſe the Supreme Being

(B) "In hoc rupis anfractu, media ferme montis altitudine, planities exigua eſt, atque in ea profundum terræ foramen, quod in oraculo patet, ex quo frigidus ſpiritus, vi quadam velut vento in ſublimè expulſus, mentes vatum in vecordiam vertit, impletaſque deo reſponſa conſulentibus dare cogit." JUST. lib. 24. c. 10.

(C) The learned author, by arguments too tedious to be here enumerated, confirms the reaſoning which we have borrowed from him; and likewiſe ſhows from hiſtory, that the prieſts, before they came to extremities with the ſacred rock, had entered into treaty with thoſe barbarians, and paid them a large tribute to decamp and quit the country. This adds greatly to the probability of his account of the exploſion; for nothing but the abſolute impoſſibility of getting quit of their beſiegers by any other means, could have induced the prieſts to hazard an experiment ſo big with danger to themſelves as well as to their enemies.

Magic.

Being to have countenanced such abominable practices by the interposition of his power, we must necessarily attribute those effects to the agency of demons, or evil spirits. Thus, when Æneas consulted the Sibyl, the agency of the inspiring god changed her whole appearance:

———————" Poscere fata
Tempus," ait: " Deus, ecce, Deus." Cui talia fanti
Ante fores, subito non vultus, non color unus,
Non comptæ mansêre comæ: sed pectus anhelum,
Et rabie fera corda tument; majorque videri,
Nec mortale sonans: afflata est numine quando
Jam propiore Dei.————

———————" Aloud she cries,
" This is the time, inquire your destinies.
He comes, behold, a god!" Thus while she said,
And shivering at the sacred entry staid,
Her colour chang'd, her face was not the same;
And hollow groans from her deep spirit came;
Her hair stood up; convulsive rage possess'd
Her trembling limbs, and heav'd her lab'ring breast;
Greater than human kind she seem'd to look,
And with an accent more than mortal spoke.
Her staring eyes with sparkling fury roll,
When all the god came rushing on her soul."
DRYDEN.

In answer to this, it is to be observed, that the temple of Apollo at Cumæ was an immense excavation in a solid rock. The rock was probably of the same kind with that on which the temple of Delphi was built, full of fissures, out of which exhaled perpetually a poisonous kind of vapour. Over one of these fissures was the tripod placed, from which the priestess gave the oracle. Now we learn from St Chrysostom, that the priestess was a woman: Quæ in tripodes sedens expansa malignum spiritum per interna immissum, et per genitales partes subeuntem excipiens, furore repleretur, ipsaque resolutis crinibus bacchaletur, ex ore spumam emittens, et sic furoris verba loquebatur." By comparing this account with that quoted above from Justin, which is confirmed both by Pausanius and by Strabo, it is evident, that what Chrysostom calls *malignum spiritum* was a particular kind of vapour blown forcibly through the fissure of the rock. But if there be a vapour of such a quality as, if received *per partes genitales*, would make a woman furious, there is surely no necessity for calling into the scene at Cumæ the agency of a demon or evil spirit. Besides, it is to be remembered, that in all mystical and magical rites, such as this was, both the priests, and the persons consulting them, prepared themselves by particular kinds of food, and sometimes, as there is reason to believe, by human sacrifices †, for the approach of the god or demon whose aid they invoked. On the present occasion, we know from the poet himself, that a cake was used which was composed of poppy-seed and honey; and Plutarch speaks of a shrub called *leucophyllus*, used in the celebration of the mysteries of Hecate, which drives men into a kind of frenzy, and makes them confess all the wickedness which they had done or intended. This being the case, the illusions of fancy occasioned by poppy will sufficiently account for the change of the sibyl's appearance, even though the inhaled vapour should not have possessed that efficacy which Chrysostom and Justin attribute to it. Even some sorts of our ordinary food occasion strange dreams, for which onions in particular are remarkable. Excessive drunkenness, as is well known, produces a disorder named by the bacchanalians of this country *the blue devils*, which consists of an immense number of spectres, accompanied with extreme horror to the person who sees them. From these facts, which cannot be denied there must arise a suspicion, that by using very unnatural food, such as human blood, the vilest of insects, serpents, and medicated cakes, by shutting themselves up in solitudes and caves, and by devising every method to excite horrid and dreadful ideas or images in the fancy, the ancient magicians might by natural means produce every phenomenon which they attributed to their gods or demons. Add to this, that in ancient times magic was studied as a science. Now, as we cannot suppose that every one who studied it intended absolutely nothing, or that all who believed in it were *wholly* deceived; what can we infer, but that the science consisted in the knowledge of those drugs which produced the phantoms in the imagination, and of the method of preparing and properly employing them for that purpose? The celebrated Friar Bacon indeed, as far back as the 13th century, wrote a book *de Nullitate Magiæ*: but though we should allow that this book proved to demonstration, that in his time no such thing as magic existed, it never could prove that the case had always been so. At that time almost all the sciences were lost; and why not magic as well as others? It is likewise an undoubted fact, that magic at all times prevailed among the Asiatics and Africans more than among the Europeans. The reason doubtless was, that the former had the requisites for the art in much greater perfection than we. Human sacrifices were frequent among them; they had the most poisonous serpents, and the greatest variety of vegetable poisons, together with that powerful narcotic opium; all which were of essential use in mystical and magic rites. They had, besides, a burning sun, frightful deserts and solitudes; which, together with extreme fasting, were all called in to their assistance, and were sufficient to produce, by natural means, the most wonderful phenomena which have ever been attributed to magical incantations. Even in our own days, we have the testimony of two travellers, whom we cannot suspect to be either liars or enthusiasts, that both the Indians and Africans perform feats for which neither they nor the most enlightened Europeans can account. The one is Mr Grose, who visited the East Indies about the year 1762; and the other is Mr Bruce, who informs us, that the inhabitants of the western coast of Africa pretend to hold a communication with the devil, and verify their assertions in such a manner that neither he nor other travellers know what to make of it: but it does not from this follow, that Mr Bruce believed that communication to be real. We have all seen one of the most illiterate men that ever assumed the title of *Doctor*, perform feats very surprising, and such as even a philosopher would have been puzzled to account for, if he had not been previously let into the secret; and yet no man supposes that *Katterfelto* holds any communication

† Vide *Lucani Pharsalia*, lib. vi. et *Arnob. C. Gentes*, lib. i.

Magic.

tion with the devil, although he has sometimes pretended it among people whose minds he supposed unenlightened.

Still it may be objected, that we have a vast number of histories of witches, who in the last century confessed, that they were present with the devil at certain meetings; that they were carried through the air, and saw many strange feats performed, too numerous and too ridiculous to be here mentioned. The best answer to this objection seems to be that given by Dr Ferriar in his essay on Popular Illusions *. "The solemn meeting of witches (says he) is supposed to be put beyond all doubt by the numerous confessions of criminals, who have described their ceremonies, named the times and places of their meetings, with the persons present, and who have agreed in their relations, though separately delivered. But I would observe, first, that the circumstances told of those festivals are in themselves ridiculous and incredible; for they are represented as gloomy and horrible, and yet with a mixture of childish and extravagant fancies, more likely to disgust and alienate than conciliate the minds of their guests. They have every appearance of uneasy dreams. Sometimes the devil and his subjects *say mass*; sometimes he *preaches* to them; more commonly he was seen in the form of a *black goat*, surrounded by imps in a thousand frightful shapes; but none of these forms are *new*, they all resemble known quadrupeds or reptiles. Secondly, I observe, that there is direct proof furnished even by demonologists, that *all* those supposed journeys and entertainments were nothing more than dreams. Persons accused of witchcraft have been repeatedly watched about the time they had fixed for their meeting: they have been seen to anoint themselves with soporific compositions; after which they fell into profound sleep; and on awaking several hours afterwards, they have related their journey through the air, with their amusement at the festival, and have named the persons whom they saw there." This is exactly conformable to the practice of the ancient magicians and diviners, and seems to be the true way of accounting, as well for many of the phenomena of magic, as for that extravagant and shameful superstition which prevailed so much during part of the last century, and by which such numbers of innocent men and women were cruelly put to death (c). We may indeed be assured, that the devil has it not in his power to reverse in a single instance the laws of nature without a divine permission; and we can conceive but one occasion (see POSSESSION) on which such permission could be given consistently with the wisdom and the goodness of God. All the tales, therefore, of diabolical agency in magic and witchcraft must undoubtedly be false; for a power, which the devil is not himself at liberty to exert, he cannot communicate to a human creature. Were the case otherwise; were those powers, "which (according to Johnson) only the controul of Omnipotence restrains from laying creation waste, subservient to the invocations of wicked mortals; were those spirits,—

——— of which the least could wield
The elements, and arm him with the force
Of all their regions,"——permitted to work miracles, and either to inflict or to remove diseases at the desire of their capricious votaries, how comfortless and wretched would be the life of man! But the matter has been long ago determined by the failure of Pharaoh's magicians; who, though by legerdemain they imitated some of the miracles of Moses, could not form the vilest insect, or stand before the disease which he inflicted upon them as well as upon others.

The revival of learning, and the success with which the laws of nature have been investigated, have long ago banished this species of magic from all the enlightened nations of Europe. Among ourselves, none but persons grossly illiterate pay the least regard to magical charms; nor are they anywhere abroad more prevalent than among the inhabitants of Lapland and Iceland. These people, indeed, place an absolute confidence in the effects of certain idle words and actions: and ignorant sailors from other parts of the world are deceived by their assertions and their ceremonies. The famous *magical drum* of the Laplanders is still in constant use in that nation; and Scheffer, in his History of Lapland, has given an account of its structure.

This instrument is made of beech, pine, or fir, split in the middle, and hollowed on the flat side where the drum is to be made. The hollow is of an oval figure; and is covered with a skin clean dressed, and painted with figures of various kinds, such as stars, suns and moons, animals and plants, and even countries, lakes and rivers; and of later days, since the preaching of Christianity among them, the acts and sufferings of our Saviour and his apostles are often added among the rest. All these figures are separated by lines into three regions or clusters.

There is, besides these parts of the drum, an index and a hammer. The index is a bundle of brass or iron rings, the biggest of which has a hole in its middle, and the smaller ones are hung to it. The hammer or drumstick is made of the horn of a rein-deer; and with this they beat the drum so as to make these rings move, they being laid on the top for that purpose. In the motion of these rings about the pictures figured on the drum, they fancy to themselves some prediction in regard to the things they inquire about.

What they principally inquire into by this instrument, are three things. 1. What sacrifices will prove most acceptable to their gods. 2. What success they shall have in their several occupations, as hunting, fishing, curing of diseases, and the like; and, 3. What is doing in places remote from them. On these several occasions they use several peculiar ceremonies, and place themselves in various odd postures as they beat the drum; which influences the rings to the one or the other side, and to come nearer to the one or the other set of figures. And when they have done this, they have a method of calculating a discovery, which they keep as a great secret, but which seems merely

* *Manchester Transactions*, vol. iii.

(c) For some farther account of popular illusions, see *Animal* MAGNETISM.

Magic Square.

merely the buſineſs of the imagination in the diviner or magician.

Magic Square, a ſquare figure, formed of a ſeries of numbers in mathematical proportion; ſo diſpoſed in parallel and equal ranks, as that the ſums of each row, taken either perpendicularly, horizontally, or diagonally, are equal.

Let the ſeveral numbers which compoſe any ſquare number (for inſtance, 1, 2, 3, 4, 5, &c. to 25 incluſive, the ſquare number) be diſpoſed, in their natural order, after each other in a ſquare figure of 25 cells, each in its cell; if now you change the order of theſe numbers, and diſpoſe them in the cells in ſuch manner, as that the five numbers which fill a horizontal rank of cells, being added together, ſhall make the ſame ſum with the five numbers in any other rank of cells, whether horizontal or vertical, and even the ſame number with the five in each of the two diagonal ranks: this diſpoſition of numbers is called a *magic ſquare*, in oppoſition to the former diſpoſition, which is called a *natural ſquare*. See the figures following:

Natural Square.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Magic Square.

16	14	8	2	25
3	22	20	11	9
15	6	4	23	17
24	18	12	10	1
7	5	21	19	13

One would imagine that theſe magic ſquares had that name given them, in regard this property of all their ranks, which, taken any way, make always the ſame ſum, appeared extremely ſurpriſing, eſpecially in certain ignorant ages, when mathematics paſſed for magic; but there is a great deal of reaſon to ſuſpect, that theſe ſquares merited their name ſtill farther, by the ſuperſtitious operations they were employed in, as the conſtruction of taliſmans, &c. for, according to the childiſh philoſophy of thoſe days, which attributed virtues to numbers, what virtues might not be expected from numbers ſo wonderful?

However, what was at firſt the vain practice of makers of taliſmans and conjurors, has ſince become the ſubject of a ſerious reſearch among mathematicians; not that they imagine it will lead them to any thing of ſolid uſe or advantage (magic ſquares ſavour too much of their original to be of much uſe); but only as it is a kind of play, where the difficulty makes the merit, and it may chance to produce ſome new views of numbers, which mathematicians will not loſe the occaſion of.

Eman. Moſchopulus, a Greek author of no great antiquity, is the firſt that appears to have ſpoken of magic ſquares: and by the age wherein he lived, there is reaſon to imagine he did not look on them merely as a mathematician. However, he has left us ſome rules for their conſtruction. In the treatiſe of Cor. Agrippa, ſo much accuſed of magic, we find the ſquares of ſeven numbers, viz. from three to nine incluſive, diſpoſed magically; and it muſt not be ſuppoſed that thoſe ſeven numbers were preferred to all the other without ſome very good reaſon: in effect, it is becauſe their ſquares, according to the ſyſtem of Agrippa and his followers, are planetary. The ſquare of 3, for inſtance, belongs to Saturn; that of 4 to Jupiter; that of 5 to Mars; that of 6 to the Sun; that of 7 to Venus; that of 8 to Mercury; and that of 9 to the Moon. M. Bachet applied himſelf to the ſtudy of magic ſquares, on the hint he had taken from the planetary ſquares of Agrippa, as being unacquainted with the work of Moſchopulus, which is only in manuſcript in the French king's library; and, without the aſſiſtance of any author, he found out a new method for thoſe ſquares whoſe root is uneven, for inſtance 25, 49, &c. but he could not make any thing of thoſe whoſe root is even.

Magic Square.

After him came M. Frenicle, who took the ſame ſubject in hand. A certain great algebraiſt was of opinion, that whereas the 16 numbers which compoſe the ſquare might be diſpoſed 20922789888000 different ways in a natural ſquare (as from the rules of combination it is certain they may), they could not be diſpoſed in a magic ſquare above 16 different ways; but M. Frenicle ſhowed, that they might be thus diſpoſed 878 different ways: whence it appears how much his method exceeds the former, which only yielded the 55th part of magic ſquares of that of M. Frenicle.

To this inquiry he thought fit to add a difficulty that had not yet been conſidered: the magic ſquare of 7, for inſtance, being conſtructed, and its 49 cells filled, if the two horizontal ranks of cells, and, at the ſame time, the two vertical ones, the moſt remote from the middle, be retrenched; that is, if the whole border or circumference of the ſquare be taken away, there will remain a ſquare whoſe root will be 5, and which will only conſiſt of 25 cells. Now it is not at all ſurpriſing that the ſquare ſhould be no longer magical, becauſe the ranks of the large ones were not intended to make the ſame ſum, excepting when taken entire with all the ſeven numbers that fill their ſeven cells; ſo that being mutilated each of two cells, and having loſt two of their numbers, it may be well expected, that their remainders will not any longer make the ſame ſum. But M. Frenicle would not be ſatisfied, unleſs when the circumference or border of the magic ſquare was taken away, and even any circumferences at pleaſure, or, in fine, ſeveral circumferences at once, the remaining ſquare was ſtill magical: which laſt condition, no doubt, made theſe ſquares vaſtly more magical than ever.

Again, He inverted that condition, and required that any circumference taken at pleaſure, or even ſeveral circumferences, ſhould be inſeparable from the ſquare; that is, that it ſhould ceaſe to be magical when they were removed, and yet continue magical after the removal of any of the reſt. M. Frenicle, however, gives no general demonſtration of his methods, and frequently ſeems to have no other guide but chance. It is true, his book was not publiſhed by himſelf, nor did it appear till after his death, viz. in 1693.

In 1703, M. Poignard, canon of Bruſſels, publiſhed a treatiſe of ſublime magic ſquares. Before him there had been no magic ſquares made but for ſerieſes of natural numbers that formed a ſquare; but M. Poignard made two very conſiderable improvements. 1. Inſtead of taking all the numbers that fill a ſquare, for inſtance the 36 ſucceſſive numbers, which would fill all the cells of a natural ſquare whoſe ſide is 6, he only takes as many ſucceſſive numbers as there are units in in the ſide of the ſquare, which, in this caſe, are ſix; and theſe ſix numbers alone he diſpoſes in ſuch manner in the 36 cells, that none of them are repeated twice in the ſame rank, whether it be horizontal, vertical, or diagonal; whence it follows, that all the ranks, taken all the ways poſſible, muſt always make the ſame ſum, which M. Poignard calls repeated progreſſion. 2. Inſtead of being confined to take theſe numbers according to the ſeries and ſucceſſion of the natural numbers, that is, in an arithmetical progreſſion, he takes them likewiſe in a geometrical progreſſion, and even in an harmonical progreſſion. But with theſe two laſt progreſſions the magic muſt neceſſarily be different from what it was: in the ſquares filled with numbers in geometrical progreſſion, it conſiſts in this, that the products of all the ranks are equal; and in the harmonical progreſſion, the numbers of all the ranks continually follow that progreſſion: he makes ſquares of each of theſe three progreſſions repeated.

This book of M. Poignard gave occaſion to M. de la Hire to turn his thoughts the ſame way, which he did with ſuch ſucceſs, that he ſeems to have well nigh completed the theory of magic ſquares. He firſt conſiders uneven ſquares: all his predeceſſors on the ſubject having found the conſtruction of even ones by much the moſt difficult; for which reaſon M. de la Hire reſerves thoſe for the laſt. This exceſs of difficulty may ariſe partly from hence, that the numbers are taken in arithmetical progreſſion. Now in that progreſſion, if the number of terms be uneven, that in the middle has ſome properties, which may be of ſervice; for inſtance, being multiplied by the number of terms in the progreſſion, the product is equal to the ſum of all the terms.

M. de la Hire propoſes a general method for uneven ſquares, which has ſome ſimilitude with the theory of compound motions, ſo uſeful and fertile in mechanics. As that conſiſts in decompounding motions, and reſolving them into others more ſimple; ſo does M. de la Hire's method conſiſt in reſolving the ſquare that is to be conſtructed into two ſimple and primitive ſquares. It muſt be owned, however, it is not quite ſo eaſy to conceive theſe two ſimple and primitive ſquares in the compound or perfect ſquare, as in an oblique motion to imagine a parallel and perpendicular one.

Suppoſe a ſquare of cells, whoſe root is uneven, for inſtance 7; and that its 49 cells are to be filled magically with numbers, for inſtance the firſt 7; M. de la Hire, on the one ſide, takes the firſt 7 numbers, beginning with unity, and ending with the root 7; and on the other 7, and all its multiples to 49, excluſively; and as theſe only make ſix numbers, he adds 0, which makes this an arithmetical progreſſion of 7 terms as well as the other; 0. 7. 14. 21. 28. 35. 42. This done, with the firſt progreſſion repeated, he fills the ſquare of the root magically: In order to this, he writes in the firſt ſeven cells of the firſt horizontal rank the ſeven numbers propoſed in what order he pleaſes, for that is abſolutely indifferent; and it is proper to obſerve here, that theſe ſeven numbers may be ranged in 5040 different manners in the ſame rank. The order in which they are placed in the firſt horizontal rank, be it what it will, is that which determines their order in all the reſt. For the ſecond horizontal rank, he places in its firſt cell, either the third, the fourth, the fifth, or the ſixth number, from the firſt number of the firſt rank; and after that writes the ſix others in order as they follow. For the third horizontal rank, he obſerves the ſame method with regard to the ſecond that he obſerved in the ſecond with regard to the firſt, and ſo of the reſt. For inſtance, ſuppoſe the firſt horizontal rank filled with the ſeven numbers in their natural order, 1, 2, 3, 4, 5, 6, 7; the ſecond horizontal rank may either commence with 3, with 4, with 5, or with 6: but in this inſtance it commences with 3; the third rank therefore muſt commence with 5, the fourth with 7, the fifth with 2, the ſixth with 4, and the ſeventh with 6. The commencement of the ranks which follow the firſt being thus determined, the other numbers, as we have already obſerved, muſt be written down in the order wherein they ſtand in the firſt, going on to 5, 6, and 7, and returning to 1, 2, &c. till every number in the firſt rank be found in every rank underneath, according to the order arbitrarily pitched upon at firſt. By this means it is evident, that no number whatever can be repeated twice in the ſame rank; and by conſequence, that the ſeven numbers 1, 2, 3, 4, 5, 6, 7, being in each rank, muſt of neceſſity make the ſame ſum.

1	2	3	4	5	6	7
3	4	5	6	7	1	2
5	6	7	1	2	3	4
7	1	2	3	4	5	6
2	3	4	5	6	7	1
4	5	6	7	1	2	3
6	7	1	2	3	4	5

It appears, from this example, that the arrangement of the numbers in the firſt rank being choſen at pleaſure, the other ranks may be continued in four different manners: and ſince the firſt rank may have 5040 different arrangements, there are no leſs than 20,160 different manners of conſtructing the magic ſquare of ſeven numbers repeated.

1	2	3	4	5	6	7
2	3	4	5	6	7	1
3	4	5	6	7	1	2
4	5	6	7	1	2	3
5	6	7	1	2	3	4
6	7	1	2	3	4	5
7	1	2	3	4	5	6

1	2	3	4	5	6	7
7	1	2	3	4	5	6
6	7	1	2	3	4	5
5	6	7	1	2	3	4
4	5	6	7	1	2	3
3	4	5	6	7	1	2
2	3	4	5	6	7	1

The order of the numbers in the firſt rank being determined; if in beginning with the ſecond rank, the ſecond number 2, or the laſt number 7, ſhould be pitched upon in one of theſe caſes, and repeated; and in the other caſe, the other diagonal would be falſe unleſs the number repeated ſeven times ſhould happen to be 4; for four times ſeven is equal to the ſum of 1, 2, 3, 4, 5, 6, 7: and in general, in every ſquare conſiſting of an unequal number of terms, in arithmetical progreſſion, one of the diagonals would be falſe according to thoſe two conſtructions, unleſs the term always repeated in that diagonal were the middle term of the progreſſion. It is not, however, at all neceſſary to take the terms in an arithmetical progreſſion; for, according to this method, one may conſtruct a magic ſquare of any numbers at pleaſure, whether they be according to any certain progreſſion or not. If they be in an arithmetical progreſſion, it will be proper, out of the general method, to except thoſe two constructions which produce a continual repetition of the same term in one of the two diagonals, and only to take in the case wherein that repetition would prevent the diagonal from being just; which case being absolutely disregarded when we computed that the square of 7 might have 20,160 different constructions, it is evident that by taking that case in, it must have vastly more.

To begin the second rank with any other number besides the second and the last, must not, however, be looked on as an universal rule: it holds good for the square of 7; but if the square of 9, for instance, were to be constructed, and the fourth figure of the first horizontal rank were pitched on for the first of the second, the consequence would be, that the fifth and eighth horizontal ranks would likewise commence with the same number, which would therefore be repeated three times in the same vertical rank, and occasion other repetitions in all the rest. The general rule, therefore, must be conceived thus: Let the number in the first rank pitched on, for the commencement of the second, have such an exponent of its quota; that is, let the order of its place be such, as that if an unit be taken from it, the remainder will not be any just quota part of the root of the square; that is, cannot divide it equally. If, for example, in the square of 7, the third number of the first horizontal rank be pitched on for the first of the second, such construction will be just; because the exponent of the place of that number, viz. 3, subtracting 1, that is, 2 cannot divide 7. Thus also might the fourth number of the same first rank be chosen, because 4—1, viz. 3, cannot divide 7; and, for the same reason, the fifth or sixth number might be taken: but in the square of 9, the fourth number of the first rank must not be taken, because 4—1, viz. 3, does divide 9. The reason of this rule will appear very evidently, by considering in what manner the returns of the same numbers do or do not happen, taking them always in the same manner in any given series. And hence it follows, that the fewer divisions the root of any square to be constructed has, the more different manners of constructing it there are; and that the prime numbers, i. e. those which have no divisions, as 5, 7, 11, 13, &c. are those whose squares will admit of the most variations in proportion to their quantities.

The squares constructed according to this method have some particular properties not required in the problem; for the numbers that compose any rank parallel to one of the two diagonals, are ranged in the same order with the numbers that compose the diagonal to which they are parallel. And as any rank parallel to a diagonal must necessarily be shorter, and have fewer cells than the diagonal itself, by adding to it the correspondent parallel, which has the number of cells by which the other falls short of the diagonal, the numbers of those two parallels, placed as it were end to end, still follow the same order with those of the diagonal: besides that their sums are likewise equal; so that they are magical on another account. Instead of the squares which we have hitherto formed by horizontal ranks, one might also form them by vertical ones; the case is the same in both.

First Primitive.

1	2	3	4	5	6	7
3	4	5	6	7	1	2
5	6	7	1	2	3	4
7	1	2	3	4	5	6
2	3	4	5	6	7	1
4	5	6	7	1	2	3
6	7	1	2	3	4	5

All we have hitherto said regards only the first primitive square, whose numbers, in the proposed example, were, 1, 2, 3, 4, 5, 6, 7; here still remains the second primitive, whose numbers are, 0, 7, 14, 21, 28, 35, 42. M. de la Hire proceeds in the same manner here as in the former; and this may likewise be constructed in 20,160 different manners, as containing the same number of terms with the first. Its construction being made, and of consequence all its ranks making the same sum, it is evident, that if we bring the two into one, by adding together the numbers of the two corresponding cells of the two squares, that is, the two numbers of the first of each, the two numbers of the second, of the third, &c. and dispose them in the 49 corresponding cells of a third square, it will likewise be magical in regard to its rank, formed by the addition of equal sums to equal sums, which must of necessity be equal among themselves. All that remains in doubt is, whether or no, by the addition of the corresponding cells of the two first squares, all the cells of the third will be filled in such manner, as that each not only contains one of the numbers of the progression from 1 to 49, but also that this number be different from any of the rest, which is the end and design of the whole operation.

Second Primitive.

0	7	14	21	28	35	42
21	28	35	42	0	7	14
42	0	7	14	21	28	35
14	21	28	35	42	0	7
35	42	0	7	14	21	28
7	14	21	28	35	42	0
28	35	42	0	7	14	21

As to this it must be observed, that if in the construction of the second primitive square care has been taken, in the commencement of the second horizontal rank, to observe an order with regard to the first, different from what was observed in the construction of the first square; for instance, if the second rank of the first square began with the third term of the first rank, and the second rank of the second square commence with the fourth of the first rank, as in the example it actually does; each number of the first square may be combined once, and only once, by addition with all the numbers of the second. And as the numbers of the first are here 1, 2, 3, 4, 5, 6, 7, and those of the second, 0, 7, 14, 21, 28, 35, 42; by combining them in this manner we have all the numbers in the progression from 1 to 49, without having any of them repeated; which is the perfect magic square proposed.

Perfect Square.

1	9	17	25	33	41	49
24	32	40	48	7	8	16
47	6	14	15	23	31	39
21	22	30	38	46	5	13
37	45	4	12	20	28	29
11	19	27	35	36	44	3
34	42	43	2	10	18	26

The necessity of constructing the two primitive squares in a different manner does not at all hinder but that each of the 20,160 constructions of the one may be combined with all the 20,160 constructions of the other: of consequence, therefore, 20,160 multiplied by itself, which makes 406,425,600, is the number of different constructions that may be made of the perfect square, which here consists of the 49 numbers of the natural progression. But as we have already observed, that a primitive square of seven numbers repeated

Magic Square.

peated may have above 20,160 feveral conftructions, the number 406,425,600 muft come vaftly fhort of expreffing all the poffible contructions of a perfect magic fquare of the 49 firft numbers.

As to the even fquares, he conftructs them like the uneven ones, by two primitive fquares; but the conftruction of primitives is different in general, and may be fo a great number of ways: and thofe general differences admit of a great number of particular variations, which give as many different conftructions of the fame even fquare. It fcarce feems poffible to determine exactly, either how many general differences there may be between the conftruction of the primitive fquares of an even fquare and an uneven one, nor how many particular variations each general difference may admit of; and, of confequence, we are ftill far from being able to determine the number of different conftructions of all thofe that may be made by the primitive fquares.

The ingenious Dr Franklin feems to have carried this curious fpeculation farther than any of his predeceffors in the fame way. He has conftructed not only a magic fquare of fquares, but likewife a magic circle of circles, of which we fhall give fome account for the amufement of our readers. The magic fquare of fquares is formed by dividing the great fquare, as in Plate CCXCVIII. The great fquare is divided into 256 fmall fquares, in which all the numbers from 1 to 256 are placed in 16 columns, which may be taken either horizontally or vertically. The properties are as follow:

1. The fum of the 16 numbers in each column, vertical and horizontal, is 2056.

2. Every half column, vertical and horizontal, makes 1028, or half of 2056.

3. Half a diagonal afcending added to half a diagonal defcending, makes 2056; taking thefe half diagonals from the ends of any fide of the fquare to the middle thereof; and fo reckoning them either upward or downward, or fidewife from left to right hand, or from right to left.

4. The fame, with all the parallels to the half diagonals, as many as can be drawn in the great fquare; for any two of them being directed upward and downward, from the place where they begin to that where they end, their fums will make 2056. The fame downward and upward in like manner: or all the fame if taken fidewife to the middle, and back to the fame fide again. *N. B.* One fet of thefe half diagonals and their parallels is drawn in the fame fquare upward and downward. Another fuch fet may be drawn from any of the other three fides.

5. The four corner numbers in the great fquare, added to the four central numbers therein, make 1028; equal to the half fum of any vertical or horizontal column which contains 16 numbers; and equal to half a diagonal or its parallel.

6. If a fquare hole (equal in breadth to four of the little fquares) be cut in a paper, through which any of the 16 little fquares in the great fquare may be feen, and the paper be laid on the great fquare, the fum of all the 16 numbers, feen through the hole, is equal to the fum of the 16 numbers in any horizontal or vertical column, viz. to 2056.

The magic circle of circles, Plate CCXCVIII. is compofed of a feries of numbers from 12 to 75 inclufive, divided into eight concentric circular fpaces, and ranged in eight radii of numbers, with the number 12 in the centre; which number, like the centre, is common to all thefe circular fpaces, and to all the radii.

The numbers are fo placed, that the fum of all thofe in either of the concentric circular fpaces above mentioned, together with the central number 12, make 360; equal to the number of degrees in a circle.

The numbers in each radius alfo, together with the central number 12, make juft 360.

The numbers in half of any of the above circular fpaces, taken either above or below the double horizontal line, with half the central number 12, make 180; equal to the number of degrees in a femicircle.

If any four adjoining numbers be taken, as if in a fquare, in the radial divifions of thefe circular fpaces, the fum of thefe, with half the central number, makes 180.

There are, moreover, included, four fets of other circular fpaces, bounded by circles which are eccentric with refpect to the common centre; each of thefe fets containing five fpaces. The centres of the circles which bound them are at A, B, C, and D. The fet whofe centre is at A is bounded by dotted lines; the fet whofe centre is at C is bounded by lines of fhort unconnected ftrokes; and the fet round D is bounded by lines of unconnected longer ftrokes, to diftinguifh them from one other. In drawing this figure by hand, the fet of concentric circles fhould be drawn with black ink, and the four different fets of eccentric circles with four kinds of ink of different colours; as blue, red, yellow, and green, for diftinguifhing them readily from one another. Thefe fets of eccentric circular fpaces interfect thofe of the concentric, and each other; and yet the numbers contained in each of the eccentric fpaces, taken all around through any of the 20 which are eccentric, make the fame fum as thofe in the concentric, namely 360, when the central number 12 is added. Their halves alfo, taken above or below the double horizontal line, with half the central number, make 180.

Obferve, that there is not one of the numbers but what belongs at leaft to two of the circular fpaces, fome to three, fome to four, fome to five; and yet they are all fo placed as never to break the required number 360 in any of the 28 circular fpaces within the primitive circle.

To bring thefe matters in view, all the numbers as above mentioned are taken out, and placed in feparate columns as they ftand around both the concentric and eccentric circular fpaces, always beginning with the outermoft and ending with the innermoft of each fet, and alfo the numbers as they ftand in the eight radii, from the circumference to the centre: the common central number 12 being placed the loweft in each column.

1. In

Magic Square.

1. In the eight concentric circular ſpaces.

14	72	23	65	21	67	12	74
25	63	16	70	18	68	27	61
30	56	39	49	37	51	28	58
41	47	32	54	34	52	43	45
46	40	55	33	53	35	44	42
57	31	48	38	50	36	59	29
62	24	71	17	69	19	60	26
73	15	64	22	66	20	75	13
12	12	12	12	12	12	12	12
360	360	360	360	360	360	360	360

2. In the eight radii.

14	25	30	41	46	57	62	73
72	63	56	47	40	31	24	15
23	16	39	32	55	48	71	64
65	70	49	54	33	38	17	22
31	18	37	34	53	50	69	66
67	68	51	52	35	36	19	20
12	27	28	43	44	59	60	75
74	61	58	45	42	29	26	13
12	12	12	12	12	12	12	12
360	360	360	360	360	360	360	360

3. In the five eccentric circular ſpaces whoſe centre is at A.

14	72	23	85	21
63	16	70	18	68
39	49	37	51	28
54	34	52	43	45
33	53	35	44	42
48	38	50	36	59
24	71	17	69	19
73	15	64	22	66
12	12	12	12	12
360	360	360	360	360

4. In the five eccentric circular ſpaces whoſe centre is at B.

30	56	39	49	37
47	32	54	34	52
55	33	53	35	44
38	50	36	59	29
17	69	19	60	26
64	22	66	20	75
72	23	65	21	67
25	63	16	70	18
12	12	12	12	12
360	360	360	360	360

5. In the five eccentric circular ſpaces whoſe centre is at C.

46	40	55	33	53
31	48	38	50	36
71	17	69	19	60
22	66	20	75	13
65	21	67	12	74
16	70	18	68	27
56	39	49	37	51
41	47	32	54	34
12	12	12	12	12
360	360	360	360	360

6. In the five eccentric circular ſpaces whoſe centre is at D.

62	24	71	17	69
15	64	22	66	20
24	65	21	67	12
70	18	68	27	61
49	37	51	28	58
32	54	34	52	43
40	55	33	53	35
57	31	48	38	50
12	12	12	12	12
360	360	360	360	360

If, now, we take any four numbers, in a ſquare form, either from N° 1. or N° 2, (we ſuppoſe from N° 1.) as in the margin, and add half the central number 12 to them, the ſum will be 180; equal to half the numbers in any circular ſpace taken above or below the double horizontal line, and equal to the number of degrees in a ſemicircle. Thus, 14, 72, 25, 63, and 6, make 180.

14	72
25	63
6	

Magic Lantern ‖ Magliabechi.

Magic Lantern. See Dioptrics, art. x.

MAGICIAN, one who practiſes magic, or hath the power of doing wonderful feats by the agency of ſpirits.

Among the eaſtern nations it ſeems to have been formerly common for the princes to have magicians about their court to confer with upon extraordinary occaſions. And concerning theſe there hath been much diſputation: ſome ſuppoſing that their power was only feigned, and that they were no other than impoſtors who impoſed on the credulity of their ſovereigns; while others have thought that they really had ſome unknown connexion or correſpondence with evil ſpirits, and could by their means accompliſh what otherwiſe would have been impoſſible for men. See the article Magic.

MAGINDANAO, or Mindanao. See Mindanao.

MAGISTERY, an old term in chemiſtry, given to precipitates. Thus, *magiſtery* and *precipitate* are ſynonymous; formerly *precipitate* was a general term, and *magiſtery* applied to particular precipitates, ſuch as the magiſtery of biſmuth, &c. See Bismuth, Chemistry *Index*.

MAGISTRATE, any public officer to whom the executive power of the law is committed either wholly or in part.

MAGLIABECHI, Antony, a perſon of great learning, and remarkable for an amazing memory, was born at Florence in 1633. His father died when he was only ſeven years old. His mother had him taught grammar and drawing, and then put him apprentice to one of the beſt goldſmiths in Florence. When he was about 16 years old, his paſſion for learning began to appear; and he laid out all his money in buying books. Becoming acquainted with Michael Ermini, librarian to the cardinal de Medicis, he ſoon perfected himſelf by his aſſiſtance in the Latin tongue, and in a little time became maſter of the Hebrew. His name ſoon became famous among the learned. A prodigious memory was his diſtinguiſhing talent; and he retained not only the ſenſe of what he had read, but

Magliabechi || Magnanimity.

but frequently all the words and the very manner of ſpelling. It is ſaid that a gentleman, to make trial of the force of his memory, lent him a manuſcript he was going to print. Some time after it was returned, the gentleman, coming to him with a melancholy countenance, pretended it was loſt, and requeſted Magliabechi to recollect what he remembered of it; upon which he wrote the whole, without miſſing a word. He generally ſhut himſelf up the whole day, and opened his doors in the evening to the men of letters who came to converſe with him. His attention was ſo abſorbed by his ſtudies, that he often forgot the moſt urgent wants of nature. Coſmo III. grand duke of Florence, made him his librarian; but he ſtill continued negligent in his dreſs, and ſimple in his manners. An old cloak ſerved him for a morning gown in the day and for bed-clothes at night. The duke, however, provided for him a commodious apartment in his palace, which he was with difficulty perſuaded to take poſſeſſion of; but which he quitted four months after, and returned to his houſe. He was remarkable for his extraordinary modeſty, his ſincerity, and his beneficence, which his friends often experienced in their wants. He was a patron of men of learning; and had the higheſt pleaſure in aſſiſting them with his advice and information, and in furniſhing them with books and manuſcripts. He had the utmoſt averſion at any thing that looked like conſtraint; and therefore the grand duke always diſpenſed with his perſonal attendance, and ſent him his orders in writing. Though he lived a very ſedentary life, he reached the 81ſt year of his age; and died in the midſt of the public applauſe, after enjoying, during the latter part of his life, ſuch affluence as few have ever procured by their learning. By his will, he left a very fine library to the public, with a fund for its ſupport.

MAGLOIRE, St, a native of Wales in Great Britain, and couſin german to St Sampſon and St Mallo. He embraced a monaſtic life, and went into France, where he was made abbot of Dol, and after that a provincial biſhop in Britanny. He afterwards founded a monaſtery in the iſland of Jerſey, where he died on the 14th of October 575, about the age of 80. His remains were tranſported to the ſuburb of St Jacques, and depoſited in a monaſtery of Benedictines, which was ceded to the fathers of the oratory in 1628. It is now the ſeminary of St Magloire, celebrated on account of the learned men whom it has produced.—This ſaint cultivated poetry with conſiderable ſucceſs: the hymn which is ſung at the feaſt of All Saints was compoſed by him; *Cælo quos eadem gloria conſecrat*, &c.

MAGNA ASSISA ELIGENDA, is a writ anciently directed to the ſheriff for ſummoning four lawful knights before the juſtices of aſſize, in order to chooſe 12 knights of the neighbourhood, &c. to paſs upon the great aſſize between ſuch a perſon plaintiff and ſuch a one defendant.

MAGNA Charta. See CHARTA.

MAGNANIMITY, denotes greatneſs of mind, particularly in circumſtances of trial and adverſity.—It has been juſtly obſerved of it, that it is the good ſenſe of pride, and the nobleſt way of acquiring applauſe. It renders the ſoul ſuperior to the trouble, diſorder, and emotion, which the appearance of great danger might excite; and it is by this quality that heroes maintain their tranquillity, and preſerve the free uſe of their reaſon, in the moſt ſurpriſing and dreadful accidents. It admires the ſame quality in its enemy; and fame, glory, conqueſts, deſire of opportunities to pardon and oblige their oppoſers, are what glow in the minds of the brave. Magnanimity and courage are inſeparable.

Beauties of Hiſtory, under the word.

1. The inhabitants of Privernum being ſubdued and taken priſoners after a revolt, one of them being aſked by a Roman ſenator, who was for putting them all to death, what puniſhment he and his fellow captives deſerved? anſwered with great intrepidity, "We deſerve that puniſhment which is due to men who are jealous of their liberty, and think themſelves worthy of it." Plautinus perceiving that his anſwer exaſperated ſome of the ſenators, endeavoured to prevent the ill effects of it, by putting a milder queſtion to the priſoner: How would you behave (ſays he) if Rome ſhould pardon you?" "Our conduct (replied the generous captive) depends upon yours. If the peace you grant be an honourable one, you may depend on a conſtant fidelity on our parts: if the terms of it be hard and diſhonourable, lay no ſtreſs on our adherence to you." Some of the judges conſtrued theſe words as menaces; but the wiſer part finding in them a great deal of magnanimity, cried out, that a nation whoſe only deſire was liberty, and their only fear that of loſing it, was worthy to become Roman. Accordingly, a decree paſſed in favour of the priſoners, and Privernum was declared a municipium. Thus the bold ſincerity of one man ſaved his country, and gained it the privilege of being incorporated into the Roman ſtate.

2. Subrius Flavius, the Roman tribune, being impeached for having conſpired againſt the life of the emperor Nero, not only owned the charge, but gloried in it. Upon the emperor's aſking him what provocation he had given him to plot his death. Becauſe I abhorred thee (ſaid Flavius), though there was not in the whole army one more zealouſly attached to thee than I, ſo long as thou didſt merit affection; but I began to hate thee when thou becameſt the murderer of thy mother, the murderer of thy brother and wife, a charioteer, a comedian, an incendiary, and a tyrant." Tacitus tells us, that the whole conſpiracy afforded nothing which proved ſo bitter and pungent to Nero as this reproach. He ordered Flavius to be immediately put to death, which he ſuffered with amazing intrepidity. When the executioner deſired him to ſtretch out his neck valiantly, "I wiſh (replied he) thou mayeſt ſtrike as valiantly."

3. When the Scythian ambaſſadors waited on Alexander the Great, they gazed attentively upon him for a long time without ſpeaking a word, being very probably ſurpriſed, as they formed a judgement of men from their air and ſtature, to find that his did not anſwer the high idea they entertained of him from his fame. At laſt, the oldeſt of the ambaſſadors (according to Q. Curtius) addreſſed him thus: "Had the gods given thee a body proportionable to thy ambition, the whole univerſe would have been too little for thee. With one hand thou wouldſt touch the eaſt, and with the other the weſt; and, not ſatisfied with this, thou wouldſt follow the ſun, and know where he hides himſelf.

Magnanimity. Magnesa || Magnet.

himself. But what have we to do with thee? we never set foot in thy country. May not those who inhabit woods be allowed to live, without knowing who thou art, and whence thou comest? We will neither command over, nor submit to, any man. And that thou mayest be sensible what kind of people the Scythians are, know, that we received from heaven as a rich present, a yoke of oxen, a ploughshare, a dart, a javelin, and a cup. These we make use of, both with our friends and against our enemies. To our friends we give corn, which we procure by the labour of our oxen; with them we offer wine to the gods in our cup; and with regard to our enemies, we combat them at a distance with our arrows, and near at hand with our javelins. But thou, who boastest thy coming to extirpate robbers, thou thyself art the greatest robber upon earth. Thou hast plundered all nations thou overcamest; thou hast possessed thyself of Lydia, invaded Syria, Persia, and Bactriana; thou art forming a design to march as far as India; and now thou comest hither to seize upon our herds of cattle. The great possessions thou hast, only make thee covet more eagerly what thou hast not. If thou art a god, thou oughtest to do good to mortals, and not deprive them of their possessions. If thou art a mere man, reflect always on what thou art. They whom thou shalt not molest will be thy true friends, the strongest friendships being contracted between equals; and they are esteemed equals who have not tried their strength against each other; but do not imagine that those whom thou conquerest can love thee."

Rapin's Hist. ann. 1199.

4. Richard I. king of England, having invested the castle of Chalus, was shot in the shoulder with an arrow; an unskilful surgeon endeavouring to extract the weapon, mangled the flesh in such a manner, that a gangrene ensued. The castle being taken, and perceiving he should not live, he ordered Bertram de Gourdon, who had shot the arrow, to be brought into his presence. Bertram being come, "What harm (said the king) did I ever do thee, that thou shouldst kill me?" The other replied with great magnanimity and courage, "You killed with your own hand my father and two of my brothers, and you likewise designed to have killed me. You may now satiate your revenge. I should cheerfully suffer all the torments that can be inflicted, were I sure of having delivered the world of a tyrant who filled it with blood and carnage." This bold and spirited answer struck Richard with remorse. He ordered the prisoner to be presented with one hundred shillings, and set at liberty: but Maccardec, one of the king's friends, like a true ruffian, ordered him to be flayed alive.

5. The following modern instance is extracted from a French work entitled, *Ecole historique et morale du soldat*, &c. A mine, underneath one of the outworks of a citadel, was intrusted to the charge of a serjeant and a few soldiers of the Piedmontese guards. Several companies of the enemy's troops had made themselves masters of this work; and the loss of the place would probably soon have followed had they maintained their post in it. The mine was charged, and a single spark would blow them all into the air. The serjeant, with the greatest coolness, ordered the soldiers to retire, desiring them to request the king to take care of his wife and children; struck fire, set a match to the train, and sacrificed himself for his country.

MAGNESA, or MAGNESIA, in *Ancient Geography*, a town or a district of Thessaly, at the foot of Mount Pelius, called by Philip, the son of Demetrius, one of the three keys of Greece, (Pausanias.)

MAGNESIA, or MAGNESIA ALBA, in *Chemistry*, a peculiar kind of earth. See CHEMISTRY *Index*.

Black MAGNESIA. See MANGANESE, CHEMISTRY and MINERALOGY *Index*.

MAGNESIA, in *Ancient Geography*, a maritime district of Thessaly, lying between the south part of the Sinus Thermaïcus and the Pegasæus to the south, and to the east of the Pelasgiotis. *Magnetes*, the people. *Magnesius* and *Magnessus*, the epithet; (Horace).

MAGNESIA, a town of Asia Minor on the Mæander, about 15 miles from Ephesus. Themistocles died there: it was one of the three towns given him by Artaxerxes, with these words, "to furnish his table with bread." It is also celebrated for a battle which was fought there, 190 years before the Christian era, between the Romans and Antiochus king of Syria. The forces of Antiochus amounted to 70,000 men according to Appian, or 70,000 foot and 12,000 horse according to Livy, which has been exaggerated by Florus to 300,000 men; the Roman army consisted of about 28,000 or 30,000 men, 2000 of whom were employed in guarding the camp. The Syrians lost 50,000 foot and 4000 horse; and the Romans only 300 killed, with 25 horse. It was founded by a colony from Magnesia in Thessaly; and was commonly called *Magnesia ad Mœandrum*, to distinguish it from another called *Magnesia ad Sipylum* in Lydia at the foot of Mount Sipylus.

MAGNESIA ad Sipylum, anciently *Tantalis*, the residence of Tantalus, and capital of Mæonia, where now stands the lake Sale. A town of Lydia, at the foot of Mount Sipylus, to the east of the Hermus; adjudged free under the Romans. It was destroyed by an earthquake in the reign of Tiberius.

MAGNET (*Magnes*) the LOADSTONE: a species of iron ore. See MAGNETISM, and MINERALOGY *Index*.

The magnet is also called *Lapis Heracleus*, from Heraclea, a city of Magnesia, a port of the ancient Lydia, where it is said to have been first found, and from which it is usually supposed to have taken its name. Though others derive the word from a shepherd named *Magnes*, who first discovered it with the iron of his crook on Mount Ida. It is also called *Lapis Nauticus*, from its use in navigation; and *siderites*, from its attracting iron, which the Greeks call σιδηρος.

The ancients reckoned five kinds of magnets, different in colour and virtue; the Ethiopic, Magnesian, Bœotic, Alexandrian, and Natolian. They also took it to be male and female: but the chief use they made of it was in medicine; especially for the cure of burns and defluxions on the eyes.—The moderns, more fortunate in its application, employ it to conduct them in their voyages. See NAVIGATION.

The most distinguishing properties of the magnet are, That it attracts iron, and that it points to the poles of the world; and in other circumstances also dips or inclines

Magnet. clines to a point beneath the horizon, directly under the pole; and that it communicates these properties, by touch, to iron. On which foundation are built the mariner's needles, both horizontal and inclinatory.

Attractive Power of the MAGNET was known to the ancients; and is mentioned even by Plato and Euripides, who call it the *Herculean stone*, because it commands iron, which subdues every thing else: but the knowledge of its directive power, whereby it disposes its poles along the meridian of every place, and occasions needles, pieces of iron, &c. touched with it, to point nearly north and south, is of a much later date; though the exact time of its discovery, and the discoverer himself, are yet in the dark. The first mention we have of it is in 1260, when Marco Polo the Venetian is said by some to have introduced the mariner's compass; though not as an invention of his own, but as derived from the Chinese, who are said to have had the use of it long before; though some imagine that the Chinese rather borrowed it from the Europeans.

Flavio de Gioia, a Neapolitan, who lived in the 13th century, is the person usually supposed to have the best title to the discovery; and yet Sir G. Wheeler mentions, that he had seen a book of astronomy much older, which supposed the use of the needle; though not as applied to the uses of navigation, but of astronomy. And in Guyot de Provins, an old French poet, who wrote about the year 1180, there is express mention made of the loadstone and the compass, and their use in navigation obliquely hinted at. Magnet, Magnetical.

The Variation of the MAGNET, or its declination from the pole, was first discovered by Seb. Cabot, a Venetian, in 1500; and the variation of that variation, by Mr Gellibrand, an Englishman, about the year 1625. See VARIATION.

Lastly, The dip or inclination of the needle, when at liberty to play vertically, to a point beneath the horizon, was first discovered by another of our countrymen, Mr R. Norman, about the year 1576. See the article *Dipping* NEEDLE.

MAGNETICAL NEEDLE. See NEEDLE, *Magnetical.*

MAGNETISM.

INTRODUCTION.

General Principles.

1 General idea of magnetism. IF the mineral body called *magnet* or *loadstone* (an ore of iron which will be described under MINERALOGY) is brought within a moderate distance from a piece of iron or steel, or other ferruginous body, such as a small key, a sewing needle, or the like, the ferruginous body will approach the magnet; and if no obstacle intervene, will come in contact with it, and the two bodies will adhere together, so as to require an evident force to separate them from each other.

2 Magnetic polarity or directive power. Again, if a magnet be freely balanced, so that it be left at liberty to assume any direction, as if be suspended by a thread, or made to float on the surface of water by placing it on a piece of cork or wood, it will soon settle itself in one particular direction, so as to turn one part of its surface towards the northern point of the horizon, and the opposite part of course towards the southern point. These two parts of the surface of the magnet are called its *north* and *south* poles; this property of the magnet, of assuming this particular direction, is called its *polarity*, or its *directive power;* and when a magnet is placed so as to arrange itself in such a direction, it is said to *traverse*.

3 Declination of the magnet. The direction in which a suspended magnet finally settles is called the *magnetic meridian*, and it is different in different places, and at different times. It is generally, however, very different from the real meridian line, so that the north pole of a magnet declines a little to the east or west, and the south pole to the west or east. The difference of the magnetic from the astronomical meridian, is called the *declination*, or *variation* of the magnet; and the declination is said to be east or west, according as the north pole of the magnet verges to the one or the other of these points.

4 Dipping of the magnet. If an oblong magnet be suspended on a pivot by its centre of gravity, it does not settle in a perfectly horizontal position, but one of its poles is depressed below the horizontal line, and the other elevated as far above it, making an angle with the horizon that is also different on different parts of the earth's surface. This depression of one of the poles is called the *dipping* of the magnet.

If two magnets that are each freely suspended, be brought within a moderate distance from each other, so that the north pole of the one is opposed to the south pole of the other, they will attract each other; and if no obstacle intervene, will rush together: but if the two north poles, or the two south poles, be mutually opposed, the magnets will repel each other. 5

Such are the leading properties of what is called the natural magnet; but what is of more importance, as we shall see hereafter, any piece of iron or steel may, by being rubbed with a natural magnet, or by some other processes to be afterwards explained, be made to acquire the same properties, and thus in every useful respect serve the same purposes as the natural magnet. These pieces of iron or steel thus magnetised, are called *artificial* magnets; and when they are of a slender, oblong form, they are termed *magnetic needles*. When afterwards we speak of the polarity, the declination, or the dipping of the magnetic needle, we would be understood as alluding to these slender, oblong, artificial magnets. 6

7 Axis and equator of a magnet. A straight line joining the two poles of a magnet is called its axis, and a line drawn transversely on the surface of the magnet, perpendicular to the axis, is called the *equator*.

8 Magnetic power. The properties of natural and artificial magnets above enumerated, are attributed to the agency of some unknown force or power, either inherent in the magnet, or imparted to it by the processes to which it is subjected. This force is sometimes called *magnetism*, but we shall for the present denominate it the *magnetic* power,

General Principles. *power*, reſtricting the term magnetiſm to the ſcience that illuſtrates and attempts to explain the phenomena.

9 Utility of magnetiſm. The moſt important property of the magnet is its polarity, as it is by means of this that the mariner is enabled to find his way along the trackleſs ocean, where, before the diſcovery of this important property, he had no other guide but the ſtars, and could therefore ſeldom venture far from the coaſt. It is by this property too, that the miner is enabled to purſue a direct courſe through the bowels of the earth, or the traveller direct his ſteps through immenſe foreſts, or over ſandy deſerts. The uſes of the magnet are therefore obvious and important, and the ſcience which places theſe uſes in the beſt point of view, and thus enables us to turn them to the greateſt advantage, is well deſerving our attention. Many of the facts to be related under this article are highly curious, and form a pleaſing addition to thoſe ſcientific amuſements which are ſo well calculated to excite the attention of beginners in the ſtudy of experimental philoſophy.

10 Works on magnetiſm. It is unneceſſary for us to attempt giving here a hiſtory of the origin and progreſs of our knowledge in magnetiſm. To a general reader, it would be unintereſting, and to ſuch as are better informed, ſuperfluous. We ſhall only mention the moſt important works that have appeared on the ſubject.

Few treatiſes expreſsly on magnetiſm have appeared in this country. In the year 1600, Dr Gilbert, a phyſician of Colcheſter, and the friend of Lord Bacon, publiſhed an excellent work *De Magnete et Corporibus Magneticis*, which is ſtill perhaps the moſt valuable that we poſſeſs. Mr Cavallo's Treatiſe on Magnetiſm, firſt publiſhed in 1787, contains a great variety of facts and experiments; and a neat compendium of it is given in the 3d volume of the ſame author's Elements of Natural and Experimental Philoſophy. Mr Cavallo's Treatiſe, and Mr Adams's Eſſay on Magnetiſm, form the ſubſtance of moſt of the compilations on this ſubject that have lately appeared.

To thoſe who wiſh to enter minutely on the ſtudy of magnetiſm, the following liſt of foreign publications recommended by the late Profeſſor Robiſon of Edinburgh will be acceptable.

Æpini Tentamen Theoriæ Magn. et Electr.

Eberhard's Tentam. Theor Magnetiſmi, 1720.

Diſſertations ſur l' Aimant, par du Fay, 1728.

Muſchenbroek Diſſert. Phyſico-Experimentalis de Magnete.

Pieces qui ont emporté la priſe de l'Acad. des Sciences à Paris ſur la meillure conſtruction des Bouſſoles de declination. Recueil des pieces couronneés, tom. v.

Euleri Opuſcula, tom. iii. continens Theoriam Magnetis. Berlin, 1751.

Æpini Oratio Academica, 1758.

Æpini item Comment. Petrop. nov. tom. x.

Anton. Brugmanni Tentamen. Phil. de Materia Magnetica. Franqueræ, 1765.

There is a German tranſlation of this work by Eiſenbach, with many valuable additions.

Scarella de Magnete, 2 tom. fol.

Van Swinden ſur l'Analogie entre les phenomenes Electriques et Magnetiques, 3 tom. 8vo.

Diſſertation ſur les Aimants Artificielles, par Nicholas Fuſs, 1782.

Eſſai ſur l'Origine des Forces Magnetiques, par M. Prevoſt. Magnetical Apparatus.

Sur les Aimants artificielles par Rivoir. Paris, 1752.

Diſſertatio de Magnetiſmo, par Sam. Klingenſtiern et Jo. Brander. Holm. 1752.

Deſcription des Courants Magnetiques. Straſbourg, 1753.

Traité de l'Aimant, par Dalancé. Amſt. 1687.

Beſides the above original works, there are ſeveral valuable diſſertations on magnetiſm by Des Cartes, Bernoulli, Euler, Du Tour, Coulomb, &c. either publiſhed in the miſcellaneous works of theſe authors, or in the journals and tranſactions of academies.

We ſhall divide this article into three chapters. In the firſt we ſhall briefly deſcribe the principal inſtruments made uſe of in magnetical experiments; in the ſecond we ſhall endeavour to arrange under diſtinct heads or propoſitions, the leading principles of magnetiſm, point out how theſe may be illuſtrated by experiment, and explain the conſtruction and uſes of the magnetical apparatus, as they are deducible from the principles laid down; and in the third we ſhall notice the more important theories of magnetiſm, and exemplify the illuſtration of ſome of the preceding facts by that theory which we ſhall feel moſt diſpoſed to adopt.

Chap. I. *Of Magnetical Apparatus.*

The principal inſtruments employed in magnetical experiments and obſervations, are reducible to three heads: Firſt, *Magnets* of various kinds and forms; Secondly, *Magnetic needles* and *compaſſes*; and, Thirdly, the *Dipping needle*. Of compaſſes we have nothing to ſay here, having fully treated of them under Compass. 11 Magnetical inſtruments.

Magnets, as we have ſaid, are either *natural* or *artificial*. The natural magnet may be cut into various forms, according to the experiments that are to be made with it. The moſt uſual ſhape is oblong, having the poles at the two moſt diſtant extremities. Dr Gilbert, whom we ſhall mention more at large hereafter, made his magnets of a ſpherical ſhape, ſo as to reſemble the terreſtrial globe. Magnets of this ſhape are called *terrellæ*, or *little earths*, and have uſually marked upon their ſurface the magnetic poles, meridian, and equator. 12 Magnets.

Natural magnets of an oblong ſhape have uſually a piece of ſoft iron attached to each pole, called the *conductor*; and another piece of ſoft iron placed ſo as to join two of the extremities of the former pieces, and uſually furniſhed with a hook or hole in the middle. The magnet thus fitted up, as repreſented at fig. 1. is ſaid to be *armed*, and the iron pieces CD, CD, are called the *armature* of the magnet AB. The magnet with its armature is commonly incloſed in a braſs box, repreſented in the figure by the dotted lines DC, CC, CD; and to the upper part of the box is fixed a ring E, for holding the magnet. 13 Armature of magnets. Plate CCXCVIII.

One of the moſt common forms of the artificial magnet is that of an oblong bar, as NS, fig. 2. of which N is the north pole, and S the ſouth, having the north end marked with a tranſverſe notch. Theſe bars are made of hardened ſteel, and are either ſold ſeparately, or what is more common, in ſets of ſix in a box.

Another very common form of the artificial magnet is

Experimental Illuſtrations.

is that of a horſe ſhoe, ſuch as fig. 3. having the two poles N, S, brought near each other, and commonly united by a piece of ſoft iron or conductor. The horſeſhoe magnets ſometimes conſiſt only of a ſingle crooked bar; but they are frequently compoſed of ſeveral ſuch bars united together by their flat ſurfaces, and incloſed in a leathern covering that envelopes all but the poles, and thus preſerves the bars from ruſting.

Inſtead of the very arched form of which horſe-ſhoe magnets are uſually made, they are ſometimes conſtructed ſo as to form nearly a ſemicircle, and in this ſhape they are very convenient for ſeveral experiments.

Artificial magnets, like the natural, when of an oblong ſhape, are ſometimes armed at each end, ſo as to enable them to apply both poles to a ferruginous body at the ſame time. One material advantage of the horſeſhoe magnet is, that in it ſuch an armature is unneceſſary, as the poles are brought ſo near each other as eaſily to be applied to the object it is propoſed to lift, as a key, &c.

14 Magnetic needle.

A *magnetic needle* is an oblong piece of ſteel, tempered ſo as commonly to aſſume the blue tinge that is ſeen in watch-ſprings, and ſupported on a braſs point, ſo as, when left at liberty, to arrange itſelf in the magnetic meridian, but in a horizontal poſition. Theſe needles are ſometimes made pointed at both extremities; ſometimes the northern extremity is made in the form of a croſs; but perhaps the beſt form is that of the oblong, with extremities that are nearly obtuſe, ſuch as is repreſented at fig. 4. To balance the needle on its pivot, it is furniſhed near its middle with a hollow cap, which is formed of ſome ſubſtance that is not attracted by the magnet. The cap is uſually of braſs; but for nice experiments it is ſometimes made of agate, as this latter does not wear ſo faſt as braſs, and conſequently the needle will longer retain its original ſuſpenſion.

15 Dipping needle.

The *dipping needle*, fig. 5. conſiſts of an oblong bar of ſteel, AB, balanced between two horizontal ſlips of braſs, CD, CD, ſo as when magnetiſed to form an angle with the horizon, equal to the dipping of the needle at the place where the inſtrument is made. The two horizontal ſlips of braſs are either fixed to a graduated ſemicircle that is ſupported on a ſtand of wood, or more commonly they form diameters to a braſs ring which is graduated on its circumference, and furniſhed with a ring H, by which it may be held on the finger.

The conſtruction and uſes of theſe inſtruments will be fully explained in the next chapter; our only object here being to bring the reader acquainted with the names and general form of the inſtruments that are made uſe of in the experiments which we are about to deſcribe, for illuſtrating the principles of magnetiſm.

Several ſmaller articles will be required by the experimentaliſt; but theſe are eaſily procured, and need no particular deſcription. Such are a number of ſewing needles of various ſizes, ſoft iron bars, pieces of iron wire, ſmall iron balls, iron filings, &c.

Chap. II. *Experimental Illuſtrations of the Principles of Magnetiſm.*

Sect. I. *Of Magnetical Polarity.*

We have ſtated (N° 3.) that when a magnet is ſuſpended at perfect freedom, it aſſumes a certain determinate poſition with reſpect to the aſtronomical meridian. This is but a particular caſe of a much more general fact, which may be expreſſed by the following *propoſition.*

Experimental Illuſtrations.

16 Iron arranges itſelf in a determinate poſition.

If *an oblong piece of iron be ſo adjuſted, as to be at liberty to take any poſition; it will aſſume a certain determinate direction with reſpect to the axis of the earth, differing according to the place where the experiment is made.*

Experiment 1.—Take a moderately ſized ſtraight iron rod, as a piece of iron wire about the thickneſs of a gooſe quill, and about eight or ten inches long; paſs it through one extremity of a large wine cork, ſo that it may be at right angles to the axis of the cork, and adjuſt it in ſuch a manner that it may ſwim in water in a horizontal poſition. Now, provide a pretty large earthen veſſel, as a hand baſon or round deep diſh, nearly filled with water; and when the water is free from agitation, cautiouſly put in the wire, in ſuch a direction as not to be very far from the north and ſouth line. The iron rod will, after ſome time, be found to have arranged itſelf ſo as, in Britain, to form an angle with the meridian of about 25 degrees.

This experiment requires ſome nicety, and it will ſometimes be long before the iron aſſumes its proper poſition; but if due attention be paid to all the particulars above mentioned, it will at length arrange itſelf in the magnetic line. It is neceſſary that the rod ſhould be placed not too far from the magnetic line, as if it be laid at right angles to that line, it will never acquire the proper direction. The ſituation of the rod in this experiment is in the true magnetic line, ſo far as reſpects the meridian; but, as it is horizontal, it is not in the poſition that a magnet would aſſume, if freely ſuſpended by its centre of gravity. An iron rod may, however, be made to take ſuch a poſition, as well as a magnet.

Exper. 2.—Inſtead of paſſing the iron rod through the extremity of a cylindrical or conical piece of cork, let it be paſſed through the centre of a ſpherical piece of cork or wood, ſo that the centre of gravity may coincide with the centre of the ſphere, and let the whole be of ſuch a ſpecific gravity as to remain ſuſpended in any part of the water, without aſcending or deſcending. If the iron rod thus fitted be placed as in the laſt experiment, it will at length arrange itſelf in the true magnetic direction, ſo as to make an angle of about 25 degrees with the meridian, and with one extremity depreſſed below the horizon at an angle of about 73 degrees.

17 Polarity of iron temporary.

Theſe experiments were contrived by Dr Gilbert, and fully ſhew that the property of aſſuming a determinate direction with reſpect to the earth's axis is not confined to magnets, or iron rendered magnetical by the uſual proceſſes. There is, however, a remarkable difference between the polarity of unmagnetiſed iron and that of natural and artificial magnets. It is of no conſequence in the former which extremity be placed towards the north, or which below the ſurface of the water, as either will retain the poſition it firſt acquired, unleſs diſturbed by agitation, or by the proximity of a magnet; and both extremities may eaſily be made to change ſituations. *The effect produced on the iron is therefore temporary.* But if a magnetic needle be

Experimental Illustrations.

freely fuſpended, the fame extremity always points towards the north, and this northern extremity always dips below the horizon, at leaſt in theſe northern latitudes; and if the poſition of the needle be diſturbed by mechanical motion, or by the application of a magnet, it will be reſumed when the diſturbing cauſe is removed. *The polarity of magnets therefore is permanent.*

18 Of magnets permanent.

19 Declination varies.

We have faid that the magnetic line varies at different times, and in different places. The declination of the magnet is ſo uncertain as to impoſe great impediments to the art of navigation, as it is neceſſary, in the courſe of a long voyage, frequently to aſcertain the degree of variation for any particular time or place. The method of doing this is mentioned under COMPASS. The declination obſerved in different places at different times, has been laid down in tables; and as ſuch tables are very uſeful, we ſhall here ſubjoin one, given by Mr Cavallo.

Latitude.	*Longitude.*	*Declination.*	*Years in which the obſervations were made.*
North.	Weſt.	Eaſt.	
70° 17′	163° 24′	30° 21′	1779
69 38	164 11	31 0	1778
66 36	167 55	27 50	
65 43	170 34	27 58	
63 58	165 48	26 25	
59 39	149 8	22 54	
58 14	139 19	24 40	
55 12	135 0	23 29	
53 37	134 53	20 32	
		Weſt.	
50 8	4 40	20 36	1776
48 44	5 0	22 38	
40 41	11 10	22 27	
33 45	14 50	18 7	
31 8	15 30	17 43	
28 30	17 0	14 0	
23 54	18 20	15 4	
20 30	20 3	14 35	
19 45	20 39	13 11	
16 37	22 50	10 33	
15 25	23 36	9 15	
13 32	23 45	9 25	
12 21	23 54	9 48	
11 51	24 5	8 19	
8 55	22 50	8 58	
6 29	20 5	9 44	
4 23	21 2	9 1	
3 45	22 34	8 27	
2 40	24 10	7 42	
1 14	26 2	5 35	
0 51	27 10	4 59	
0 7	27 0	4 27	
South.			
1 13	28 58	3 12	
2 48	29 37	2 52	
3 37	30 14	2 14	
4 22	30 29	2 54	
5 0	31 40	1 26	

Experimental Illustrations.

Latitude.	*Longitude.*	*Declination.*	*Years in which the obſervations were made.*
South.	Weſt.	Weſt.	
6° 0′	32° 50′	0° 6′	1776
		Eaſt.	
6 45	33 30	0 35	
		Weſt.	
7 50	34 20	0 7	
8 43	34 20	0 15	
		Eaſt.	
9 1	34 50	0 44	
		Weſt.	
10 4	34 49	0 38	
		Eaſt.	
12 40	34 49	1 12	
13 23	34 49	1 1	
14 11	34 49	1 9	
15 33	34 40	1 15	
16 12	35 20	2 4	
18 30	35 50	3 2	
20 8	36 1	5 26	
21 37	36 9	3 24	
24 17	36 8	3 24	
26 47	34 27	3 44	
28 19	32 20	1 58	
30 25	26 28	2 37	
		Weſt.	
33 43	16 30	4 44	
35 37	9 30	5 51	
38 52	23 20	22 12	
	Eaſt.	Eaſt.	
40 36	173 34	13 47	
42 4	167 32	13 17	
		Weſt.	
44 52	155 47	9 28	
46 15	144 50	14 48	
48 41	69 10	27 39	

It is of ſtill more importance to know the progreſſive change of the declination at any certain place, and we ſhall therefore give here the following table of the declination as obſerved at London in different years, from 1576 to 1800.

Years.	*Declination.*	*Obſervers.*
	Eaſt.	
1576	11° 15′	Burrowes.
1580	11 11	
1612	6 10	
1622	6 0	Gunter.
1633	4 6	
1634	4 5	Gellibrand.
	Weſt.	
1656	0 0	Bond.
1665	1 $22\frac{1}{2}$	Gellibrand.
1666	1 $35\frac{1}{2}$	
1672	2 30	Halley.

Experimental Illustrations.

Years.	*Declination.*	*Observers.*
	West.	
1683	4 30	
1692	6 0	
1700	8 0	
1717	10 42	
1723	14 17	
1748	17 40	Graham.
1760	19 12	
1765	20 0	
1770	20 35	
1773	21 9	Heberden.
1775	21 30	
1780	22 10	
1785	22 50	
1787	23 19	Gilpin.
1790	23 34	
1795	23 57	Gilpin.
1800	24 7	
1802	24 6	Gilpin.
1805	24 8	

From this last table it appears that when the declination was first observed, the north pole of the magnetic needle declined to the eastward of the meridian of London, that since that time it advanced continually towards the west till 1657, when the needle pointed due north and south, and that ever since it has continually declined more and more towards the west, in which direction it appears to be still advancing.

At Paris, in different years, the declination has been observed as follows :

In 1550	-	8° 0′	East.
1640	-	3 0	
1660	-	0 0	
1681	-	2 2	West.
1759	-	18 10	
1760	-	18 20	

From 1792 to 1794		21° 54′	Stationary.
In 1798	-	22 17	
1799	-	22 0	
1800	-	22 12	
1801	-	22 1	
1802	-	21 45	
1803	-	21 59	
1804	-	22 10	
At Jamaica 1805	-	6 30	E.

At Alexandria in Egypt,

In 1761	-	11° 4′	W.
1798	-	13 6	

At Cairo,

In 1761	-	12° 25	W.
1798	-	12	

The declination of the magnetic needle has been found to be different, even at different hours of the day. The following table contains the result of some observations made by Mr Canton on the daily variation, and, on the mean variation of each month.

The declination observed at different hours of the same day. June 27. 1759.

	H. Min.	Decl. W.	Degrees of the Therm.	The mean Variation for each Month in the Year.	
Morning.	0 18	12° 2	62°	January,	7′ 8″
	6 4	18 58	62	February,	8 52
	8 30	18 55	65	March,	11 17
	9 2	18 54	67	April,	12 26
	10 20	18 57	69	May,	13 0
	11 40	19 4	68½	June,	13 21
Afternoon.	0 50	19 9	70	July,	13 14
	1 38	19 8	70	August,	12 19
	3 10	19 8	68	September,	11 43
	7 20	18 59	61	October,	10 36
	9 12	19 6	59	Nobember,	8 9
	11 40	18 51	57½	December,	6 58

Table of the Mean Monthly Variation of the Magnetic Needle for 20 Years at London *.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	Septemb.	October.	Novemb.	Decemb.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1786	-	-	-	-	-	-	-	-	23 16.4	23 18.4	23 17.3	23 18.3
1787	23 19.2	23 19.8	23 20.3	23 18.5	23 17.0	23 18.3	23 19 6	23 21.9	23 22.8	23 24.5	23 25.0	23 25.8
1788	23 25.6	-	-	-	-	23 28.9	23 29.8	-	-	23 32.1	-	-
1789	-	-	-	-	-	23 34.2	-	-	-	-	-	23 41.2
1790	23 38.9	-	-	-	-	-	23 39 0	-	-	-	-	-
1791	23 35.6	-	-	23 36.0	-	-	23 36.7	-	-	-	-	-
1792	23 41.1	-	-	-	23 41.9	-	-	23 43.6	23 43.9	23 45.6	23 45 9	23 45.2
1793	23 46.9	23 48.3	23 48.8	23 46.2	23 47.3	23 48.5	23 50.5	23 48.6	23 52.6	23 52.3	23 51.9	23 52.3
1794	23 54.2	-	-	-	-	-	23 54.4	23 57.2	23 58.1	-	-	-
1795	-	-	23 57.5	-	-	23 57.1	23 57.1	-	24 0.4	-	-	23 59.4
1796	-	-	24 1.1	-	-	23 58.7	23 59.2	-	24 0.1	-	-	24 1.3
1797	-	-	24 1.5	-	-	24 0.2	24 0.3	-	24 1.4	-	-	24 1.3
1798	-	-	24 0.6	-	-	23 59.4	24 0.0	-	24 1.4	-	-	24 1.4
1799	-	-	24 1.1	-	-	24 0.6	24 1.8	-	24 2.9	-	-	24 2.3
1800	-	-	24 3.6	-	-	24 1.8	24 3.0	-	24 3.6	-	-	24 3.3
1801	-	-	24 5.2	-	-	24 2.8	24 4.1	-	24 3.8	-	-	24 5.4
1802	-	-	24 6.9	-	-	24 5.3	24 6.0	-	24 8.7	-	-	24 6.8
1803	-	-	24 8.0		-	24 7.0	24 7.9	-	24 10.5	-	-	24 10.7
1804	-	-	24 9.4	-	-	24 6.0	24 8.4	-	24 8.9	-	-	24 9.0
1805	-	-	24 8.7	-	-	24 7.8	24 7.8	-	24 10.0	-	-	24 9.4

* Phil. Trans. 1806. p. 416.

Charts

Experimental Illuſtrations.

Charts have been conſtructed for ſhewing the declination of the needle in various parts of the earth by means of curve lines. Reſpecting theſe charts and ſeveral other circumſtances with regard to this ſubject, ſee VARIATION *of the Compaſs*.

It may not be improper here to point out the general method of applying the polarity of the magnet to the uſeful purpoſes of navigation, mining, &c.

A mariner's compaſs, or magnetic needle in a caſe, is ſo placed as to be as little as poſſible diſturbed by the motion of the veſſel, perſon, &c. In a ſhip, it is placed in the binnacle (ſee BINNACLE), or ſuſpended from the upper deck in the cabin. Then the head of the veſſel is kept by the helm in ſuch a direction as to make any required angle with the line of the needle, or the perſon (in mining or travelling) advances in a ſimilar manner. Thus, ſuppoſing that a veſſel ſets out from a certain part, in order to go to another place that is exactly weſtward of the former; as for example, from the Land's End in Cornwall to Newfoundland on the coaſt of North America. The veſſel muſt be directed in ſuch a way, as that its courſe may be always at right angles with the direction of the magnetic needle, or ſo that the part of the needle or compaſs card, which points to the northward, (allowing for the variation) may be always kept to the right hand of the man at the helm, or to the ſtarboard ſide of the veſſel. The reaſon of this is evident; for, ſuppoſing the needle to point duly north and ſouth, the direction of eaſt and weſt being perpendicular to it, this muſt be the true courſe of the veſſel. From this example, a little reflection well eaſily point out how a veſſel may be ſteered in any other courſe (A.)

20 Polarity diſturbed by the approach of iron.

The declination of the magnetic needle is diſturbed by the near approach of a ferruginous body, eſpecially if this be of conſiderable ſize.

On holding the extremity of a pretty large iron rod, ſuch as a poker, near one end of a magnetic needle properly ſuſpended, the needle will be found to turn conſiderably from its uſual direction. This circumſtance, though proper to be mentioned here, will be better underſtood when we have conſidered the attractive power of the magnet. The fact is uſeful, as it teaches us to keep magnetic needles in ſuch a ſituation as not to be acted on by any conſiderable body of iron.

A magnet, whether natural or artificial, has a greater effect in diſturbing the polarity of a magnetic needle than is produced by iron.

Experimental Illuſtrations.

Magnetic polarity ſeems alſo to be affected by changes in the ſtate of the atmoſphere; and the following axioms reſpecting this effect on the declination of the needle, collected by M. la Cotte, are deſerving of attention.

1. The greateſt declination of the needle from the north towards the weſt, takes place about two in the afternoon; and the greateſt approximation of it towards the north, about eight in the morning; ſo that from the laſt mentioned hour till about two in the afternoon, it endeavours to remove from the north, and between two in the afternoon and the next morning, to approach it.

2. The annual progreſs of the magnetic needle is as follows:—Between January and March, it removes from the north; between March and May it approaches it; in June it is ſtationary; in July it removes from it; in Auguſt, September, and October it approaches it; its declination in October is the ſame as in May; in November and December it removes from the north; its greateſt weſtern declination is at the vernal equinox, and its greateſt approximation to the north, at the autumnal equinox.

3. The declination of the magnetic needle is different, according to the latitude; among us, (i. e. in France) it has always increaſed ſince 1657; before that period it was eaſterly.

4. Before volcanic eruptions and earthquakes, the magnetic needle is often ſubject to very extraordinary movements.

5. The magnetic needle is agitated before and after the appearance of the northern lights: its declination on theſe occaſions is about noon greater than uſual.

So much has already been ſaid reſpecting the phenomena, &c. of the dipping needle, under the article *DIPPING Needle*, that it is unneceſſary here to add much more on the ſubject. It was there noticed, that at the equator the dipping needle lies quite horizontal, and that one of its extremities inclines more towards the earth, according as the inſtrument is carried farther from the equator. We may here add, that from ſome late obſervations made by experimentaliſts with balloons, it appears that the higher we aſcend above the ſurface 21

(A) In reply to ſome inquiries reſpecting the mode of employing the compaſs in mining, we were favoured by an ingenious friend, who is manager of one of the moſt extenſive coalworks in this iſland, with the following remarks: "The compaſs is uſed in all mines where great accuracy is required. In ſome coal-mines the *cleats* or *faces* of the coal are the guides to the miners in excavating the mine, and the compaſs is uſed to aſcertain the ſituation and extent of the excavations. In other coal-mines the courſes of the excavations are at firſt directed by the compaſs. In doing this, the compaſs is placed in a given ſituation, and is made to point the deſired courſe. Then from the centre of one ſight a perpendicular line is conveyed to the roof of the mine, and a ſmall mark is there made with chalk; then a perſon looks at a candle (placed ſo as nearly to touch the roof), through the lower part of the ſight of the compaſs neareſt to him, and through the upper part of the oppoſite ſight. The candle at the roof is moved in any direction until he ſees it through both ſights of the compaſs. It is then in a proper place, and a chalk mark is made in the roof immediately above it. A line ſtruck with a chalked cord, between theſe two marks upon the roof, marks the proper courſe, by which the workmen are directed in making the excavation. By applying one part of a chalked cord along part of the courſe or white line thus begun on the roof, and extending the other part of the cord paſt it to any required diſtance, and then ſtriking the cord, the courſe may be continued from time to time as the excavation advances."

Experimental Illustrations.

surface of the earth, the leſs is the angle of inclination which the dipping needle makes with the horizontal line *.

It is worthy of remark that, under the ſame circumſtances, the declination of the needle was not found different from what it would have been on the earth at the ſame place, and its polarity with reſpect to iron was unchanged.

* Nicholſ. Jour. 8vo. xi. p. 54.

In an aëroſtatic voyage made at St Peterſburgh in 1804 by M. M. Sacharof and Robertſon, it was obſerved that the *ſouth* pole of a magnetic needle, balanced on a pin, dipped below the horizon nearly 10 degrees.

Experimental Illustrations.

The following table ſhows the magnetic dip as obſerved at ſeveral different places at various times.

Latitude.	*Longitude.*	*N. Pole below the Horizon.*	*Years of Obſervation.*	*Latitude.*	*Longitude.*	*N. Pole below the Horizon.*	*Years of Obſervation.*
North.	Eaſt.			South.			
53° 55′	193° 39	69° 10′	1778	0° 3′	27° 38′	30° 3′	
49 36	233 10	72 29		4 40	30 34	22 15	
	Weſt.			7 3	33 21	17 57	
44 5	8 10	71 34	1776	11 25	34 24	9 15	
38 53	12 1	70 30			Eaſt.	*S. Pole below.*	
34 57	14 8	66 12		16 45	208 12	29 28	
29 18	16 7	62 17		19 28	204 11	41 0	
24 24	18 11	59 0		21 8	185 0	39 1	1777
20 47	19 36	56 15		35 55	18 20	45 37	1774
15 8	23 38	51 0		41 5	174 13	63 49	1777
12 1	23 35	48 26		45 47	166 18	70 5	1773
10 0	22 52	44 12		Prince of Wales's Iſland.		5 10	1799
5 2	20 10	37 25					

*Table of the Magnetic Dip at London, from 1786 to 1805.**

* Phil. Tranſ. 1806. p. 419.

			Poles Reverſed.		
	Face eaſt.	Face weſt.	Face eaſt.	Face weſt.	True dip.
1786 September	72 28,7	72 1,4	71 57,3	72 5,1	72 8,1
October	72 29,9	71 59,0	72 0,4	72 1,2	72 7,6
November	72 7,6	72 17,6	72 2,4	71 46,7	72 3,6
December	72 10,6	72 2,2	72 2,2	71 58,4	72 3,4
1787 January	72 11,4	72 1,8	72 1,0	71 56,0	72 2,5
February	72 19,4	72 10,8	72 1,5	71 55,8	72 6,9
March	72 19,1	72 11,9	72 0,5	71 52,2	72 5,9
April	72 24,4	72 9,5	72 0,5	71 52,2	72 6,6
May	72 24,4	72 9,6	72 4,2	71 52,9	72 7,8
June	72 22,6	72 7,9	72 4,2	71 52,9	72 6,8
July	72 22,6	72 7,9	71 59,9	71 55,1	72 6,4
Auguſt	72 22,3	72 6,7	72 59,3	71 55,2	72 5,9
September	72 22,3	72 6.7	72 2,9	71 51,0	72 5,7
October	72 23,1	72 2,5	72 2,9	71 51,0	72 4,9
November	72 23,1	72 2,5	72 2,7	71 50,3	72 4,7
December	72 22,8	72 2,0	72 2,7	71 50,3	72 4,4
1788 January	72 22,8	72 2,0	72 2,6	71 48,8	72 4,0
1789 January	72 16,0	72 0,0	71 51,9	71 31,1	71 54,8
December	72 17,5	71 59.4	71 38,9	71 42,8	71 54,6
1790 January	72 16,9	71 57,7	71 40,2	71 40,2	71 53,7
1791 January	71 43.9	71 36,1	71 37,2	71 17,5	71 23,7
1795 October	71 12,8	71 9,5	71 13,9	71 9,4	71 11,4
1797 October	71 4,9	71 10,9	70 56,3	70 44,7	70 59,2
1798 April	71 4,7	71 14,5	71 2,3	70 19,8	70 55,4
October	70 55,6	71 14,5	71 7,7	70 22,2	70 55,0
1799 October	70 56,0	71 13,5	71 11,5	70 7,9	70 52,2
1801 April	70 47,4	71 5,6	70 52,4	69 38,2	70 35,6
1803 October	70 30,9	71 9,9	70 40,5	69 46,7	70 32,0
1805 Auguſt	70 25,2	70 55,7	70 26,9	69 36,3	70 21,0

To

Experimental Illuſtrations.

To what was ſaid under *Dipping Needle*, reſpecting the conſtruction of that inſtrument, we may add, that, notwithſtanding the great improvements that have been lately made in the arts, the making of a dipping needle is one of the moſt delicate and difficult taſks that an inſtrument-maker can undertake. The needle muſt be made of tempered ſteel which we are certain has no magnetiſm before it is touched; it muſt be poiſed ſo nicely, and with ſuch a perfect coincidence of its centre of gravity and axis of motion, that it will retain any poſition (before being magnetiſed) that is given it. A good dipping needle cannot be had below *twenty guineas*.

Sect. II. *On Magnetic Attraction and Repulſion.*

22 A magnet attracts iron and all ferruginous bodies.

A magnet attracts iron, and all bodies, into the compoſition of which iron enters in any conſiderable degree. This principle is illuſtrated by very ſimple experiments, which will readily occur to every reader. It is of conſequence here to obſerve, that the purer and ſofter the iron to which the magnet is preſented, the ſtronger will be the attraction; thus, a magnet attracts a piece of ſoft and clean iron much more ſtrongly than it attracts any other ferruginous body of the ſame ſhape and weight. Hard ſteel, or the harder ores of iron, are leſs forcibly attracted than ſoft ſteel, and ſtill leſs than ſoft iron; and all pieces of iron are leſs forcibly attracted in proportion as they are more oxygenated.

22 Attraction greateſt at the poles.

The attractive power of a magnet is not equally ſtrong on every part of its ſurface. It is moſt powerful at the poles of the magnet, and it is found to diminiſh in proportion as the part of the ſurface is more diſtant from the poles. Thus, in an oblong magnet, the attraction is leaſt at about its middle, where it is often very trifling.

23 Method of finding the poles of a magnet.

It is by this property of the magnet that we are enabled to diſcover the poles of a magnet, where they are not yet aſcertained; a circumſtance which is often neceſſary with reſpect to natural magnets, in which, when of an irregular ſhape, it would otherwiſe be difficult to diſcover the poles. The uſual method of aſcertaining the poles of a magnetic body is, to preſent various parts of the body to be examined, ſucceſſively to the poles of a magnetic needle, when it will ſoon be diſcovered which parts of the body have moſt influence on the needle, by the pole of the latter ſtanding perpendicularly to that part of the body. It will preſently appear, that in this way it may alſo be aſcertained which of theſe poles is the north, and which the ſouth, as the ſouth pole of the body under examination will have moſt influence on the north pole of the needle, and *vice verſa*.

A good magnet ſhould have no more than two poles, and theſe ſhould be ſituated in the extreme ſurface of the magnet; but it ſometimes happens, eſpecially in natural magnets, and in artificial magnetic bars, if they be very long, that there are more than two poles, or that the poles are very confuſed. For example, in a very long magnetiſed bar, there may be a ſtrong north pole at one extremity, a ſouth pole a little farther on, then a weaker north pole, and ſo on to the extremity, which will be found poſſeſſed of a ſtill weaker ſouth polarity. Theſe poles are to be diſcovered by preſenting to the ſeveral parts of the bar one or other of the poles of a magnetic needle; for, as we ſhall immediately mention, each pole of the needle will be attracted towards that part of the rod which is poſſeſſed of the contrary polarity.

The attractive power of the magnet and the iron is moſt forcible when the two bodies are in contact, and it diminiſhes as they are made to recede from each other. The exact law according to which this diminution takes place, has not yet been completely aſcertained. We ſhall ſee in the next chapter, what approximation has been made to it.

24 Different attractive power of magnets,

A magnet is not capable of lifting above a certain weight of iron; and all magnets of the ſame form and ſize are not able to lift the ſame weight. Among the natural magnets the ſmalleſt ſeem in general to poſſeſs a greater attractive power in proportion to their ſize, than thoſe of larger dimenſions. Mr Cavallo mentions a ſmall magnet that weighed not more than 6 or 7 grains, and was capable of lifting about 300 grains; and Sir Iſaac Newton poſſeſſed a magnet that he wore in a ring, weighing but about 3 grains, which is ſaid to have lifted 746 grains, or nearly 250 times its own weight. The larger natural magnets are very weak in proportion to theſe. Thoſe of two pounds ſcarcely lift more than ten times their own weight. It ſeems extraordinary, that a piece cut off from a large magnet is ſometimes much ſtronger in reſpect of its attractive power, than the magnet from which it was taken.

It has been ſaid that the attractive power of magnets is greateſt at their poles. Both poles, however, are ſeldom equal in this reſpect; and it appears, that in theſe northern parts of the world, the north pole of magnets is more powerful than the ſouth. In the ſouthern hemiſphere the contrary effect is ſaid to take place. The attractive power of the magnet is moſt forcible when both poles are made to act conjointly; hence an armed magnet, or one of the horſe-ſhoe form, is beſt adapted for experiments on the force of magnetic attraction.

It is of little conſequence whether the iron that is 25
preſented to the magnet be in one piece, or conſiſt of ſeveral pieces. The attraction is indeed ſtronger in the former caſe; but if ſeveral pieces of iron are preſented to the magnet, they will either all adhere about the pole of the magnet, or will adhere to each other, ſo as to form a ſort of chain. If a ſmall iron ball be made to adhere to the pole of a magnet, this ball will ſupport a ſecond; and this latter, if the magnet be pretty ſtrong, will ſupport a third. If the magnet be of the horſe-ſhoe form, and have theſe three balls hanging by one ball, if two others be ſuſpended from the other pole, all the five may be made to adhere, ſo as to form a curved chain. It will be evident, that pieces of iron which preſent a greater extent of ſurface than the above ſpherical balls, will be more powerfully attracted.

26 Action of a magnet on iron filings.

One of the moſt pleaſing experiments on the attraction of the magnet for iron, is ſhewn by means of iron filings.

Exper.—Let a paper be placed above a bar magnet, and let iron filings be ſhaken on the paper through a gauſe ſieve. They will arrange themſelves round the magnet in a very beautiful manner, forming curves and arches of curves, as repreſented in fig. 6. At the two ends of the magnet, as *a a*, there are chains of filings ſtanding out nearly perpendicular; and along the ſides they

Experimental Illuſtrations.

they form complete curves, bending outwards away from the magnet towards its middle, and having their extremities bounded by the poles of the magnet; and at the corners there are a number of arches that ſeem to form imperfect curves.

A ſimilar effect may be produced by ſtrewing iron filings on a piece of paper, ſo as to leave a vacancy in the middle, capable of receiving a bar magnet. When the magnet is placed on the paper, and the paper gently tapped, ſo as to agitate the filings, theſe will arrange themſelves about the magnet, in curves, as above deſcribed.

The form of theſe curves will be better defined if the magnet be laid at the bottom of an earthen or glaſs veſſel of water, and the iron filings be ſifted over it ſo as to paſs through the water.

27 Attraction between the magnet and iron mutual.

The attraction between a magnet and a ferruginous body is mutual.

Exper.—Place a piece of iron or other ferruginous body upon a piece of cork or wood, ſo that it may float on the ſurface of water in an earthen or wooden veſſel. Bring a magnet within a moderate diſtance of the floating body, and the latter will approach the former, and may be drawn by it in any direction. Again, place the magnet on cork or wood, ſo as to float on the water, and preſent to it a piece of iron, or other ferruginous body. The magnet will now approach the iron, and may be drawn by it as the iron was before. Laſtly, Place both the magnet and the iron on ſeparate pieces of wood or cork, within a moderate diſtance of each other, on the ſurface of the water. They will gradually approach each other, with a velocity that becomes greater in proportion as they approach nearer each other.

28 Magnetic attraction not ſenſibly leſſened by the interpoſition of bodies not ferruginous.

Magnetic attraction is not ſenſibly impeded by the interpoſition of bodies of any kind, that do not contain iron in their compoſition.

Exper.—Suppoſe that a magnet, placed at the diſtance of an inch from a piece of iron, exerts a certain degree of attraction, it will be found that the attraction is not ſenſibly weakened by the interpoſition of a plate of glaſs, a ſheet of paper, a piece of copper, or any other ſimilar ſubſtance. A needle, incloſed in a glaſs globe, will be ſtill attracted by the magnet.

29 Uſual mode of meaſuring the attractive force.

It is not eaſy to aſcertain correctly the degree of attractive force exerted between a magnet and a ferruginous body. The uſual method of obſerving this is, to faſten a magnet to one arm of a balance, and placing the body to be attracted at different diſtances below the magnet, to counterpoiſe the attraction with weights placed in the oppoſite ſcale of the balance. Proceeding in this way, then, if we find that it requires the weight of an ounce to counterpoiſe the attractive power of a magnet, when preſented immediately to a piece of iron, it will be found that it requires the ſame counterpoiſe, if a plate of any matter that is not ferruginous be interpoſed.

30 Iron attracts iron in certain ſituations.

Not only is iron attracted by the magnet, but *under certain circumſtances, one piece of iron exerts an attractive power on another piece of iron.*

Exper.—Let an oblong piece of iron be fixed in a ſpherical piece of wood or cork, ſo as to float in water in the true magnetic line, as in Exper. 2. of N° 16. When the iron is nearly in the magnetical poſition, bring the extremity of a large iron rod, as the point of a new poker, holding it in a poſition not very different from that of the iron wire, within about a quarter of an inch of the upper extremity of the floating iron, and hold it there for ſome time, a little towards one ſide. The floating wire will gradually approach the iron rod with an accelerated motion, will at length touch it, and may be drawn through the water in any direction. A ſimilar attraction will take place between the head of the poker and the extremity of the wire that is below the water.

31 Magnetic attraction increaſed by iron.

The attractive power of the magnet is increaſed by the near approach of a piece of iron.

Exper. 1.—Suppoſe we have a magnetic bar that is capable of ſupporting a ſmall key by one of its extremities, but which will not lift a key ſomewhat larger. If we bring a conſiderable oblong piece of iron near the oppoſite extremity of the bar, it will be found capable of ſupporting the larger key, or at leaſt of lifting a weight ſomewhat greater than it ſuſtained before.

Exper. 2.—Let an oblong magnetic bar be ſupported in a horizontal poſition, and let a piece of iron wire, about an inch in length, be hung by a ſhort thread, ſo that its extremity is juſt oppoſite one of the poles of the magnetic bar, but ſo far out of the reach of the bar's attractive power as not to be brought from the perpendicular. Now, if a conſiderable iron bar be brought with one end within a moderate diſtance of the oppoſite pole of the magnet, the ſuſpended wire will be drawn towards the magnet, thus ſhewing that the power of the latter has been increaſed by the juxtapoſition of the bar of iron. If the bar of iron be brought ſtill nearer the oppoſite pole of the magnet, the ſuſpended wire will be drawn ſtill nearer its adjacent pole; but if the bar of iron be drawn back from the magnet, the wire will fall into its original poſition.

This fact leads to many important practical concluſions in the management of magnets. As the juxtapoſition of iron to the *poles* of a magnet improves its powers, we may infer, that if we keep a piece of ſoft iron in contact with the poles, the magnet will be improved by it; and this is in fact the caſe, and it ſhews the utility of the armature and conductor mentioned in N° 13. But of this more hereafter.

32 Power of a magnet increaſed by hanging weights to it.

The attractive power of a magnet may be improved by increaſing the weight appended to it.

This is beſt ſhown by a horſe-ſhoe magnet, having a conductor of ſoft iron attached to its two poles, and a braſs ring at the convex part by which it may be ſuſpended. If a ſmall bag be hung to the conductor, and if the magnet is capable of containing a certain weight at any particular time, it will, by adding a little more, ſuppoſe a few ſhot, to the bag, at moderate intervals, be made to ſupport gradually a much greater weight. If the magnet, on a firſt trial, was able to lift a ſmall key, it will ſoon be able to lift a larger one, &c. How far this increaſe of power may be carried, has not, we believe, yet been aſcertained.

It ſometimes happens that a magnet does not ſhew any great attractive power, as exemplified in its power of lifting a conſiderable weight of iron, though it may have a great effect in exciting or in altering magnetic polarity. This was obſerved by Dr Gilbert, who remarks

Experimental Illustrations.

marks that the *directive* power of a magnet extends *farther* than its *attractive* power.

33 Contrary poles of magnets attract each other.

The contrary poles of two magnets attract each other; that is, the north the south, and vice versa.

Exper. 1.—Place two oblong magnets on cork or wood, so as to float in water, or suspend each by a pretty long thread, with the north pole of the one opposed to the south pole of the other. They will gradually approach, and will at length rush together.

A similar effect will be produced, if the north pole of a bar magnet be held near the south pole of a magnetic needle; the latter will be attracted, and the same thing will happen if the south pole of the bar is brought near the north pole of the needle.

Exper. 2.—Take two semicircular magnets, and dip their extremities into iron filings. The filings will of course adhere to the extremities of the magnets, and will appear as if radiating from them. Now, present the two magnets with their adhering filings to each other, so that the north and south pole of the one is opposite to the contrary poles of the other, and the iron filings at their extremities will approach each other, and coalesce, as represented in fig. 7.

The attraction exerted between two magnets is not so strong in proportion, as between a magnet and a piece of soft iron in contact; but it has been found to commence at a greater distance.

34 Corresponding poles repel each other.

The corresponding poles of two magnets repel each other; that is, the north the north, and the south the south.

Exper. 1.—Make the two magnets float on water, or suspend them by threads, so that the north or south pole of the one may be opposite to the north or south pole of the other. They will recede from each other, and the repulsion will evidently be greater, in proportion as they are brought nearer together.

Exper. 2.—Take two semicircular magnets, and dip their ends in iron filings, as mentioned above. Present them to each other, so that their corresponding poles may be mutually opposed. The filings at their extremities will start back, and leave a vacancy between the opposed poles of the magnets, somewhat like what is represented in fig. 8.

It sometimes happens that the corresponding poles of two magnets do not repel each other, but either mutually attract, or are quite indifferent. In this case, it will, in general, be found that one of them is stronger than the other; and the reason of the phenomenon will appear hereafter.

The repulsive power of a magnet is generally in a less proportion than its attractive power.

35 Usual mode of ascertaining whether a body is magnetic.

It is by the attractive power of the magnet that we usually ascertain whether any substance be magnetic; that is, whether the magnet possess any attractive power for it. If the body contain any considerable quantity of iron in its composition, its magnetism is easily ascertained, by approaching it with the pole of a pretty strong magnetic bar. If, however, the magnetism is too feeble to be discovered in this way, it may be ascertained by placing the body on a piece of cork or wood, so that it may float on the surface of water or mercury, in an earthen or wooden vessel, and bringing the pole of the magnet within a small distance of the floating body. It will sometimes be necessary to bring the magnet within one-tenth of an inch of the body, when, if it possesses any magnetism, it will gradually approach the magnet. This experiment is most satisfactory when the body to be examined is made to float on mercury; but in that case the vessel containing the mercury must not be too small, otherwise the natural convexity of the surface of the mercury will cause the floating body perpetually to fall down towards the sides of the vessel. A common soup plate will answer the purpose very well. It is also necessary that the mercury be very pure, and as clean as possible. To insure this, it will be proper, before using the mercury, to pass it through a conical piece of writing paper, rolled up so as to terminate in a very small aperture; or what is better, to squeeze it through a pretty thick piece of shamois leather. It need scarcely be remarked, that in these delicate experiments, the air of the room should be kept as still as possible.

By the above methods, Mr Cavallo and others discovered, that the following substances are in some measure affected by the magnet. Most metallic ores, especially after their having been exposed to a fire; zinc, bismuth, and particularly cobalt, as well as their ores, are almost always attracted. Of the earths, the calcareous is the least, if at all, and the siliceous is the most frequently, attracted. The ruby, the chrysolite and the tourmalin, are attracted. The emerald, and particularly the garnet, are not only attracted, but frequently acquire a permanent polarity. The opal is weakly attracted, especially after combustion. Most animal and vegetable substances, after combustion, are attracted. Even soot, and the dust which usually falls upon whatever is left exposed to the atmosphere, are sensibly attracted by the magnet.

"It has long ago been remarked, that platina, nickel, and several other bodies, acquire a sensible degree of magnetism; but some philosophers attribute this property only to a portion of iron not easy to be separated, and conclude, that by obtaining a greater degree of purity, we might succeed in rendering them perfectly indifferent to the action of the magnetic bar. 36 Coulomb's experiments on universal magnetism.

"The new experiments which Citizen Coulomb has made and repeated before the institute, lead us on the contrary to think, that the action of magnetism extends through all nature; for none of the bodies he has yet tried was found to resist this power.

"But however real this action may be, it is not alike in all bodies, and in most of them it must be necessarily very small, to have escaped the attention of philosophers to this time. In order, therefore, to exhibit and to measure these results, we must begin by placing the bodies in a situation which shall allow them to yield to the weakest action.

"For this purpose, Citizen Coulomb fashioned his subjects into the form of a cylinder or small bar; and in this state he suspended them to a silken thread, such as is drawn from the silk worm's cone, and in this state he placed them between the opposite poles of two magnetic bars of steel. The single thread of silk could hardly bear the weight of a quarter of an ounce without breaking, consequently it became necessary to form small bars very light and thin. Citizen Coulomb made them about seven or eight millimetres in length (or less than half an inch), with three-fourths of a millimetre (or

Experimental Illuſtrations.

(or about an hundredth part of an inch) in thickneſs, and he gave the metals about one-third of this thickneſs.

" In his experiments he placed the ſteel bars in the ſame right line, their oppoſite poles being five or ſix millimetres farther aſunder than the length of the needle intended to oſcillate between them. The reſult of the experiment ſhewed, that whatever might be the ſubſtance of the needle, it always diſpoſed itſelf according to the direction of the two bars; and that if they were turned from this direction, they always recovered it, after oſcillations of which the number was often more than 30 per minute. It was therefore eaſy in every caſe to determine, from the weight and figure of the needle, the force which had produced the oſcillation.

" Theſe experiments were ſucceſsfully made with ſmall needles of gold, ſilver, copper, lead, tin, ſmall cylinders of glaſs, a piece of chalk, a fragment of bone, and different kinds of wood.

" Citizen Coulomb has proved, that the force of torſion of the ſilk thread is ſo ſlight, that in order to draw it round the entire circle, it would require a force ſcarcely equal to the one hundred thouſandth part of a gramm, (or about one ſeven hundredth part of a grain). A quantity ſo minute cannot therefore ſenſibly derange the meaſure of magnetic force in the different bodies; and its effect, even if it were admitted to be of perceptible magnitude, may alſo be urged in proof of the general concluſion of Citizen Coulomb, becauſe the magnetic power muſt overcome this reſiſtance of the thread in order to manifeſt itſelf. Our author gives, in the third volume of the Memoirs of Natural Philoſophy and Mathematics of the National Inſtitute, a very ſimple formula to determine the magnetic force of a body from the time of its oſcillations; and he means to ſhew in another memoir, the method of determining this reſult in different bodies of the ſame figure placed between the poles of two bars. He thinks it now proved, that all the elements which enter into the compoſition of our globe are ſubjected to the magnetic power, and that the whole maſs collectively forms one ſingle magnet.

" In favour of thoſe who might be deſirous of repeating his experiments, and rendering them very ſenſible, the author remarks, that the method of ſucceeding conſiſts in diminiſhing the ſize of the oſcillating bodies. From ſome eſſays, of which the reſults terminate this memoir, it ſeems to follow, that the accelerating forces are inverſely as the maſſes, or very nearly in the direct proportion of the ſurfaces; but Citizen Coulomb gives this rule only as a firſt deduction, which requires to be confirmed *."

The opinion of the general influence of magnetiſm on all terreſtrial bodies was, as we ſhall ſee hereafter, maintained by our countryman Dr Gilbert, though Coulomb has certainly the merit of having put it to the teſt of experiment.

* *Nichol. Journ.* 8vo. vol. ii.

37 Entertaining experiments.

Beſides the experiments which we have related, there are ſome that depend on the attractive power of the magnet, and which are ranked among ſcientific amuſements. We ſhall here deſcribe a few of theſe.

Before we relate the manner of making theſe experiments, it may be proper to deſcribe an inſtrument that is employed in ſome of them. This, from its form and apparent uſe, is called the magnetic perſpective glaſs, and is thus conſtructed.

38 Conſtruction of the magnetic perſpective glaſs.

Provide an ivory tube about $2\frac{1}{2}$ inches long, and of ſuch a form as is expreſſed in fig. 9. The ſides of this tube muſt be ſo thin as to admit a conſiderable quantity of light. It is to open at one end with a ſcrew, and at that end muſt be placed an eye-glaſs of about two inches focus, and at the other end any glaſs you pleaſe. Have a ſmall magnetic needle like that in a compaſs. It muſt be ſtrongly touched, and ſo placed at the bottom of the tube that it may turn freely round. It is to be fixed on the centre of a ſmall ivory circle C, of the thickneſs of a counter, placed on the object-glaſs D, and painted black on the ſide next it. This circle muſt be kept faſt by a circular rim of paſteboard, that the needle may not riſe off its pivot, in the ſame manner as in the compaſs. This tube will thus become a kind of compaſs ſufficiently tranſparent to ſhow the motions of the needle. The eye-glaſs ſerves more clearly to diſtinguiſh the direction of the needle, and the glaſs at the other end, merely to give the tube the appearance of a common perſpective glaſs. It will appear, from what has been already ſtated, that the needle in this tube, when placed over and at a ſmall diſtance from a magnet, or any machine in which it is contained, will neceſſarily place itſelf in a poſition directed by that magnet, and conſequently ſhow where the north and ſouth pole of it is placed; the north end of the needle conſtantly pointing to the ſouth end of the magnet. This effect will take place, though the magnet be encloſed in a caſe of wood, or even metal. You muſt obſerve, however, that the attracting magnet muſt not be very far diſtant from the needle, eſpecially if it be ſmall, as in that caſe its influence extends but to a ſhort diſtance. This tube may be differently conſtructed, by placing the needle in a perpendicular direction, on a ſmall axis of iron, on which it muſt turn quite freely, between two ſmall plates of braſs placed on each ſide of the tube; the two ends of the needle ſhould be in exact equilibrium. The north and ſouth ends of the needle will, in like manner, be attracted by the ſouth and north ends of the magnetic bar. The former conſtruction, however, appears preferable, as it is more eaſily excited, and the ſituation of the needle much more eaſily diſtinguiſhed.

Exp. 1. *The communicative Piece of Money.*

39 Communicative piece of money.

Take a crown or dollar, and drill a hole in the ſide of it, in which place a piece of wire, or a large needle well poliſhed, and ſtrongly touched with a magnet. Then cloſe the hole with a ſmall piece of pewter, that it may not be perceived. Now, the needle in the magnetic perſpective before deſcribed, when it is brought near to this piece of money, will fix itſelf in a direction correſponding to the wire or needle in that piece. Deſire any perſon to lend you a crown piece or dollar, which you dexterouſly change for one that you have prepared as above. Then give the latter piece to another perſon, and leave him at liberty either to put it privately in a ſnuff-box, or not; he is then to place the box on a table, and you are to tell him by means of your glaſs, whether the crown is or is not in the box. Then bringing your perſpective cloſe to the box, you will know, by the motion of the needle, whether it be there or not; for as the needle in the perſpective will

Experimental Illustrations. always keep to the north of itself, if you do not perceive it has any motion, you conclude the crown is not in the box. It may happen, however, that the wire in the crown may be placed to the north, in which case you will be deceived. Therefore, to be sure of success, when you find the needle in the perspective remain stationary, you may, on some pretence desire the person to move the box into another position, by which you will certainly know whether the crown-piece be there or not. You must remember that the needle in the perspective must here be very sensible, as the wire in the crown cannot possibly have any great attractive force.

Exp. 2. *The Magnetic Table.*

40 Magnetic table. Under the top of a common table place a magnet that turns on a pivot, and fix a board under it, that nothing may appear. There may also be a drawer under the table, which you pull out to shew that there is nothing concealed. At one end of the table there must be a pin that communicates with the magnet, and by which it may be placed in different positions; this pin must be so placed as not to be visible to the spectators. Strew some steel filings or very small nails over that part of the table where the magnet is. Then ask any one to lend you a knife or a key, which will then attract part of the nails or filings. Then placing your hand in a careless manner on the pin at the end of the table, you alter the position of the magnet, and giving the key to any person, you desire him to make the experiment, which he will then not be able to perform. You then give the key to another person, at the same time placing the magnet, by means of the pin, in the first position, when that person will immediately perform the experiment.

Exp. 3. *The Mysterious Watch.*

41 Mysterious watch. You desire any one in company who has a watch with a steel balance, (B) to lend it you for a few minutes, asking him whether it will continue to go when laid on the table. He will probably say it will. To prove to him that he is wrong, you lay it on that part of the table below which you have previously placed a strong bar-magnet (as in Exp. 2.), so that the watch may be above one of the poles. It will immediately stop. Now, if you shift the position of the magnet, and give the watch to another person to lay it on the table, it will not stop, but replacing the magnet, and desiring a third person to try the experiment, he will succeed. All this, to those who are not acquainted with the secret, will appear very extraordinary.

Exp. 4. *The Magnetic Dial.*

42 Magnetic dial. Provide a circle of wood or ivory, of about five or six inches diameter, as fig. 10. which must turn quite free on the stand B (fig. 11.), in the circular border A: on the circle must be placed the dial of pasteboard C (fig. 10.), whose circumference is to be divided into 12 equal parts, in which must be inscribed the numbers from 1 to 12, as on a common dial. There must be a small groove in the circular frame D, to receive the pasteboard circle; and observe that the dial must be made to turn so freely that it may go round without moving the circular border in which it is placed. Between the pasteboard circle and the bottom of the frame, place a small artificial magnet E (fig. 12.) that has a hole in its middle, or a small protuberance. On the outside of the frame place a small pin P, which serves to shew where the magnetic needle I, that is placed on a pivot at the centre of the dial, is to stop. This needle must turn quite freely on its pivot, and its two sides should be in exact equilibrium. Then provide a small bag, that has five or six divisions, like a lady's work-bag, but smaller. In one of these divisions put small square pieces of pasteboard on which are written the numbers from 1 to 12, and if you please you may put several of each number. In each of the other divisions you must put 12 or more like pieces, observing, that all the pieces in each division must be marked with the same number. Now the needle being placed upon its pivot, and turned quickly about, it will necessarily stop at that point where the north end of the magnetic bar is placed, and which you previously knew by the situation of the small pin in the circular border. You therefore present to any person that division of the bag which contains the several pieces on which is written the number opposite to the north end of the bar, and tell him to draw any one of them he pleases. Then placing the needle on the pivot, you turn it quickly about, and it will necessarily stop, as we have already said, at that particular number.

Another experiment may be made with the same dial, by desiring two persons to draw each of them one number out of two different divisions of the bag; and if their numbers, when added together, exceed 12, the needle or index will stop at the number they exceed it; but if they do not amount to 12, the index will stop at the sum of those two numbers. In order to perform this experiment, you must place the pin against the number 5, if the two numbers to be drawn from the bag be 10 and 7; or against 9, if they be seven and two. If this experiment be made immediately after the former, as it easily may, by dexterously moving the pin, it will appear the more extraordinary.

Exp. 5. *The Divining Circles.*

On the top of a thin box, as AB fig. 13. paste two circles drawn on paper, as F, G, each of which is divided into compartments. In those of one circle, as G, are written questions, and in those of the other, as F, appropriate answers. Through the centre of the circle G an axle passes, carrying a toothed wheel, and which works into the pinion *d*, to the axis of which is fixed another pinion, and this receives the teeth of another wheel *g*, whose axis is passed through the centre of the circle F. On the axis of the wheel *c* is to be fixed an index *a* above the paper circle, and to the axis of the wheel *g* just below the cover of the box, is fixed a bar magnet *q q*, turning together with the axis; while on the part of the axis that projects above the circle F a loose needle *x x* is balanced, so as to move independently of the axis. A carton of strong paper, of the size of 43 Divining circles.

(B) The balance of a watch is sometimes, though very seldom, made of brass, when it is scarcely susceptible of magnetic influence.

Experimental Illuſtrations.

of F ſhould cover the paſted circle, and turn eaſily on the centre *z*; and it ſhould have a triangular piece as F cut out, in order to ſee the anſwers. If now the needle be taken off its point, and a perſon be deſired to aſk ſome of the queſtions on the circle G, the index muſt be turned to the queſtion, and then the needle placed on its pivot, giving it a whirl round. When it ſtops, its point will ſtand over the proper anſwer, which may be ſeen by turning the open part of the carton to that place.

SECT. III. *Of the Communication and Production of Magnetiſm.*

The whole of this important part of the ſubject may be ſaid to depend on one general fact, which we ſhall therefore firſt lay down and illuſtrate.

44 Iron becomes magnetical by proximity to a magnet.

Any piece of iron when in the neighbourhood of a magnet, is itſelf a magnet, and poſſeſſes all the material properties of that body.

Ex. 1. Let there be a large and ſtrong magnet properly ſupported in the horizontal direction, at a diſtance from iron or other ſimilar bodies, and with its poles perfectly free. Take alſo any ſmall piece of common iron, not more than two or three inches long, ſuch as a common ſmall key, and take another piece of iron, as a ſmaller key, or ſhort piece of wire about the ſize of a gooſe quill.

In the firſt place hold the key in a horizontal poſition, with one end oppoſite one of the poles of the magnet, but ſo as not to be in contact with it. Then bring the other piece of iron to the other end of the key, and it will hang by the key, and will ſo continue to hang, though we withdraw the key from the magnet horizontally, till there is a certain interval between the key and the magnet, when the former will be no longer able to ſupport the piece of iron. Even at this diſtance the key will, however, be found capable of ſupporting a piece of iron conſiderably ſmaller than the former, till its diſtance from the magnet be increaſed.

Again, hold the key with one extremity below one of the poles of the magnet, and touch the other extremity with the ſmall piece of iron, the latter will adhere till the key be removed too far below the magnet.

Thirdly, Hold the key with one of its extremities above one of the poles of the magnet, but at ſuch a diſtance that there is room for the ſmall piece of iron to go between the key and the magnet, without touching the latter. The piece of iron will be ſupported by the key, as in the two former inſtances.

Fourthly, Let the magnet be placed in a vertical poſition, and hold the key with one extremity immediately below or above one of the poles. The piece of iron will be ſupported in a ſimilar manner, in the former caſe by the extremity of the key that is moſt remote from the magnet, and in the latter by that which is adjacent.

If, inſtead of approaching the magnet with the key, we reverſe the circumſtances, the effect of the magnet in rendering the key magnetical will be ſtill more evident. Suppoſe the piece of iron to be lying on the table; let one end of it be touched with the key, and there will be found no attraction between them: but if while we hold the key very near one extremity of the wire, we bring the pole of the magnet near the other end of the key, we ſhall ſee the wire riſe from the table, and adhere to the key.

Experimental Illuſtrations.

In all theſe caſes the attractive power of the key, that is, its magnetiſm, is evidently derived from its juxtapoſition to the magnet.

Exp. 2. Let two pieces of iron wire be ſuſpended by ſeparate ends of a piece of thread, ſo that they may be hung from a pin in the wall in a ſituation parallel to each other, or in contact. Now bring one end of a bar magnet a little below the wires, and they will repel each other. If theſe wires are of ſoft iron, they will collapſe immediately on the magnet being withdrawn; but if they are formed of hard iron or of ſteel, they will continue apart for a conſiderable time.

Here the two wires are, by the proximity of the magnet, become magnets, and the extremities next the bar have each acquired a ſimilar polarity, i. e. both contrary to that of the adjacent pole of the bar. They, therefore, repel each other.

Exp. 3. Let a bar-magnet, ſuch as N, S, fig. 14. be laid in a horizontal poſition, and let a ſmall key, as B, C, be held near the north pole of the magnet, in the direction of its axis. Let a very ſmall magnetic needle, ſupported on a ſharp pivot, be brought near that end of the key C, which is moſt remote from N. The needle will immediately turn its ſouth pole towards C, as is indicated by the feathered part of the arrow *c*. Hence it appears that the key has acquired a directive power like a magnet, and that its remote extremity performs the office of a north pole, as it attracts the ſouth pole of the needle, and repels its north pole. If it be ſaid that the magnetic needle in this caſe is affected directly by the directive power of the magnet, as it would take the above poſition though the key were not preſent; to ſhew that the effect is produced through the medium of the key, remove the needle into another ſituation as *b*, and it will ſtill arrange itſelf with the ſame pole oppoſite C, and if it be carried to the proximate extremity of the key, as at *a*, it will turn round, and preſent its north pole to B, thus ſhewing that it is, at leaſt in ſome meaſure, influenced by the key.

45 Neareſt end acquires a polarity contrary to that of the adjacent pole of the magnet.

In general, when a piece of iron is preſented to the pole of a magnet, the extremity next that pole is poſſeſſed of the contrary polarity, and the remote extremity has acquired a ſimilar polarity. The ſituation of the poles, however, depends much on the form of the piece of iron, and on the part of its ſurface which is preſented to the pole of the magnet. If the form be that of an oblong bar, one extremity of which is preſented to the pole, which is the moſt uſual caſe, the circumſtances will be as we have juſt mentioned. If the oblong bar be preſented to the pole in a perpendicular direction, with its middle very near the pole of the magnet, this middle point will be poſſeſſed of a polarity contrary to that of the adjacent pole, while the two extremities have acquired the ſame polarity. If the preſented iron be in the form of a circular plate, and its centre be held near the pole of the magnet, this centre will have the contrary polarity, and every point of the circumference the ſame polarity. If the plate have its circumference faſhioned into points, each of theſe points will acquire a very ſtrong polarity, contrary to that of the pole near which the centre of the plate is held.

The communication of magnetic power from the

magnet

Experimental Illustrations. magnet to the key in the foregoing experiments, will be ftill more ftrongly illuftrated by holding another piece of wire to the wire that is already fufpended by the key. The new piece of wire will alfo be fufpended, and fo feveral more may be fufpended by one another, like the links of a chain, according to the ftrength of the magnet. This fact was known to the ancients, who fpeak of a loadftone caufing an iron ring to carry another ring; and that a third, till the whole puts on the appearance of a chain.

46 Induced magnetifm. It will be found that the magnet has loft none of its power by producing magnetifm in the iron, and of courfe, that nothing has been *transferred* from the magnet to the iron. The magnetifm of the iron thus caufed by its juxtapofition to a magnet is called *induced magnetifm*, or *magnetifm by induction*.

47 Apparent exception. There is an apparent exception to the univerfality of the above propofition. If the key be held in fuch a pofition as that it fhall be perpendicular to the magnet, with one extremity either oppofite one of the poles, or a little above the centre of the magnet, the bit of wire will not be attracted by that extremity, and we may hence fuppofe that the key has acquired no magnetic power by its proximity to the magnet. But if we bring a needle or a piece of iron wire near its remote end, it will be ftrongly attracted, and fhew that end to have the fame polarity with the neareft pole of the magnet. Now, the ends both of the key and the wire that are next the magnet, having the fame polarity with the pole of the magnet neareft them, cannot attract each other, but on the contrary will repel each other, and therefore the wire cannot adhere to the key, though by the change produced by the other extremity, it is evident that the key has acquired magnetic power.

48 Real exception. There is, however, one exception. If the key in the firft experiment, with the wire hanging to it, be carried from any of the fituations there defcribed, towards the middle of the magnet, the wire will fall off as foon as it arrives very near the middle. If we fuppofe a plane to pafs through the centre of the magnet in a direction perpendicular to its axis, fo as to form the magnetic equator, a flender piece of iron held any where within this plane can acquire no fenfible magnetifm, which is demonftrated by its fhewing no figns of polarity, and not being attracted by the magnet. Now it is well known that the greateft activity of a magnet refides in its two poles, and that thofe magnets are the beft in which this activity is leaft diffufed. A certain circumference of every magnet is entirely inactive, as we fee in the experiment with the iron filings defcribed in N° 26. where the filings collect themfelves principally on two points of the furface, between which there is a fpace all round, to which no filings are attached. Many circumftances fhew that the two poles of a magnet have contrary actions; the north pole producing a ftrong northern polarity in the remote end of an iron bar brought near it, and a fouth polarity in the proximate end, while an oppofite effect is produced by its fouth pole. Now, adopting this principle, that the actions of the two poles are oppofite, it follows that if thefe actions are equal, and act in a fimilar manner, each muft counteract and prevent the action of the other, and produce what may be called a *magnetic equilibrium*. Therefore if a flender iron rod or thin plate be placed fo that every part of it lies within the magnetic equator, it will exhibit no magnetifm, will not be attracted by the magnet, and will not attract iron. This will be feen more fatisfactorily when we have explained the theory of magnetifm. Experimental Illuftrations.

The confideration of the above important facts will enable us to explain, efpecially after what will be ftated in the next chapter, the production or communication of magnetifm in all the methods by which thefe are ufually effected.

Magnetifm may be produced artificially in a piece of iron or fteel, by various methods. 49 Artificial magnetifm produced;

1. *By touching the iron or fteel either with a natural magnet, or with a fteel bar already magnetized.* 50 By *touching* with a magnet.

The procefs of communicating magnetifm by natural or artificial magnets, or by what has been called *touching*, has undergone various improvements and modifications, which we fhall endeavour briefly to trace.

The moft fimple method of magnetizing a bar of fteel is to apply the north pole of a magnet to that extremity of the bar which we wifh to acquire a fouth polarity. In this way, merely by contact, a flight degree of magnetic power will, after fome time, be imparted to the bar, and the communication will be expedited by ftriking the bar fo as to make it found. Only a flight degree of magnetifm can, however, be communicated in this way, and unlefs the fteel bar be very fhort, its poles will be much confufed. 51 Old methods.

Another method of communicating magnetifm to a bar of this kind is, to apply the pole of a magnet to one end of the bar, and pafs it on to the other end, giving a moderate degree of preffure. This is repeated feveral times on both fides of the bar, taking care always to begin the ftroke at the fame end as at firft, and inftead of drawing the magnet back along the bar, lifting it up every time that we come to the other end. The following defcription will beft explain the mode of communicating magnetifm in this way, by one or two magnetic bars.

When only one magnetic bar is to be made ufe of, one of its poles muft be applied as reprefented fig. 15. where CD reprefents the needle or fteel bar to be impregnated. The magnet AB is then to be drawn all along the furface of it, till it reaches the extremity D. The magnet being then removed, muft be applied to the extremity C, and drawn over the needle as before. Thus the needle muft be rubbed feveral times, by which means it will acquire a confiderable degree of magnetifm. In this method, the other extremity of the needle which the magnet touched laft acquires the contrary magnetifm; that is, if B be the north pole of the magnet, C will be the north pole and D the fouth of the needle. This method, however, is never found to be equally effectual with that in which two magnets, or both poles of one magnet, are made ufe of.

To communicate magnetifm by means of two magnetic bars, place the bar or needle AB, fig. 16. upon a table; then fet the two magnetic bars CD, EF, ftraight upright upon it at a little diftance, equal on both fides from the middle of the bar AB, and in fuch a manner that the fouth pole D of one of the bars may be neareft to that end of the bar AB which is to become the north pole, &c. Thefe two bars muft then be flid gradually towards one extremity of the bar, keeping them conftantly at the fame diftance from each other; and when one of them, for inftance CD, is arrived

Experimental Illustrations.

rived at A, then they muſt be ſlid the contrary way, till EF arrives at B; and thus the bar AB muſt be rubbed a greater or ſmaller number of times, till it will be found by trial to have acquired a conſiderable power. When the magnetic bars are powerful, and the bar AB of very good ſteel, and not very large, a dozen of ſtrokes are fully ſufficient; but when the bars are to be removed from the bar AB, care muſt be taken to bring them to the ſame ſituation where they were firſt placed; viz. a little and equal diſtance from the middle of the bar AB, from which they may be lifted up.

The mode of employing two bars inſtead of one was an improvement, and the method was ſtill farther improved by placing them in an inclined poſition, with their extremities C, E, remote from each other, and ſliding them contraryways from the middle towards each extremity of the bar AB, lifting them up when they come to the extremities, and replacing them on the middle of the bar, thus repeating the operation as often as required.

52 Method of touching curved bars.

Horſe-ſhoe bars, or thoſe of a ſemicircular form, may be magnetized in a ſimilar manner, except that the magnetic bars employed for the purpoſe muſt follow the curvature of the bar to be impregnated. The following is the method uſually employed for magnetizing bars of this kind. The crooked bar is laid flat upon a table, and to each of its extremities is applied a ſtraight magnetic bar, as DF, EG, fig. 17. and the remote extremities of theſe bars F, G, are joined by the conductor or piece of ſoft iron FG. Then to its middle are to be applied two magnetic bars, with their oppoſite poles at a little diſtance from each other, H, I, and with theſe the crooked bar is to be ſtroked from end to end, following the direction of the crooked bar, ſo that on one ſide of it the magnetic bars may ſtand in the direction repreſented by the dotted lines at K and L. When in this manner the piece of ſteel ABC has been rubbed a ſufficient number of times on the one ſide, it is to be turned, and the ſame operation repeated on the other ſide, taking care that the adhering magnetic bars, and the conductor of ſoft iron, be preſerved in the ſame ſituation as at firſt. It muſt be obſerved that in this proceſs the magnets DF, DG, as well as the magnets H, I, muſt be placed ſo that their ſouth poles ſhall be towards that extremity of the bar which is to be made a north pole.

53 Duhamel's improvement.

A material improvement in the proceſs for communicating magnetiſm from artificial magnets to ſteel bars, was introduced by Duhamel. He formed a right-angled parallelogram, two of the ſides of which were made by two equal bars of ſteel, that were intended to be magnetized, while the other two were formed by joining the extremities of the ſteel bars by two pieces of ſoft iron, alſo equal to each other in length, but much ſhorter than the ſteel bars. Then taking two parcels of bars already magnetized, he brought together their oppoſite poles towards the middle of one of the ſteel bars forming the parallelogram, and inclining the parcels as in fig. 18. he made them glide gently, ſeparating them from each other towards the extremities of the bar; and this operation was repeated as often as required, when the inclined parcels of magnetic bars were carried to the oppoſite bars of the parallelogram, and this was rubbed in a ſimilar manner. After the bars were rubbed ſufficiently on one ſide, they were, as in former caſes, turned on the other.

This method is one of the beſt that we can employ for magnetizing the needles of compaſſes, and ſuch ſteel bars as are of a moderate thinneſs, eſpecially if we employ magnetic bars ſtrongly impregnated for the purpoſe of rubbing the ſteel bars.

Much about the time that M. Duhamel contrived the above method, the ſame object was employing the attention of experimental philoſophers in England, where the proceſs of magnetizing bars was much improved by Mr Mitchell and Mr Canton. 54 Improvement by Mitchell and Canton.

Mr Mitchell employed two parcels of bars already ſtrongly magnetized, joined together in a parallel direction, with their oppoſite poles united at each extremity, but in ſuch a manner, that there remained between the two parcels a ſmall interval. He then placed a number of equal ſteel bars in a ſtraight line, and made one extremity of the magnetized bars ſlide over the line formed by the ſteel bars at right angles; and this he repeated as uſual. In this way he found that the intermediate bars in the ſtraight line acquired a great degree of magnetic power.

Mr Canton placed the bar which he wiſhed to magnetize, ſo as to form part of a parallelogram, as in the method of M. Duhamel, and then employed the ſame means as Mr Mitchell for impregnating the bar, after which he ſeparated the two parcels of magnets, and inclining them to each other in the manner of Duhamel upon the bar, he made them ſlide from the needle towards the extremities. This laſt method conſiderably augmented, according to Mr Canton, the magnetic power of the bar; but by Coulomb it is conſidered as the only effectual part of the proceſs. Theſe methods of Mitchell and Canton conſtitute what has been called the double touch, which was ſtill farther improved by the celebrated Æpinus.

This philoſopher, after having formed a parallelogram with ſteel bars, and pieces of ſoft iron, in the manner of Duhamel, placed upon the bar to be magnetized, two parcels of magnetic bars inclined in ſuch a way that each of them formed on its own ſide an angle of 15° or 20° with the ſteel bar on which it was placed; their oppoſite poles being at a very ſmall diſtance from one another. Keeping the parcels of magnetic bars in the ſame relative ſituation with reſpect to each other, he made both parcels ſlide along alternately from the middle of the bar towards each extremity, beginning at every renewal of the operation from the middle of the bar. This method has a very great advantage over the former, as by it we may magnetize bars of conſiderable length and thickneſs, by means of magnetic bars that have no great magnetic power. 55 Method of Æpinus.

In all theſe proceſſes it muſt be remarked, that, in order to proceed properly, it is neceſſary to employ a conſiderable degree of preſſure. A parallelogram of ſteel bars and ſoft iron ſhould be kept firm by wedges, ſomewhat in the manner of printers types, and the extremities of the magnetic bars ſhould be perfectly cleaned. Dr Robiſon ſuppoſed, that wetting theſe extremities conſiderably aided the proceſs; but he found that the leaſt particle of oil between the bars greatly obſtructed it, as did the ſmalleſt piece of the thinneſt gold leaf. He found that bars which were rough acquired a more powerful 56 Remarks.

Experimental Illustrations.

powerful magnetiſm than thoſe which were moderately poliſhed; but that, if moderately rough, they acquired the firſt degrees of magnetiſm more expeditiouſly than ſmooth bars, but did not receive ſo ſtrong an impregnation as the latter.

57 Improvements of Coulomb.

The method of making artificial magnets has been greatly improved by M. Coulomb, who in a ſeries of memoirs, printed in the Memoirs of the Academy of Sciences, and of the National Inſtitute of Paris, has communicated a number of valuable obſervations and experiments that have contributed, perhaps more than any preceding labours, to the advancement both of the theory and practice of magnetiſm. Many years ago he publiſhed his proceſs for making very powerful artificial magnets.

In his operations he uſes four very ſtrong magnets previouſly impregnated. He placed his two ſtrongeſt magnets, (as NS, NS, fig. 19.) on an horizontal plane in one right line, at ſuch a diſtance that they might be a few lines nearer to each other than the length of the needle *n s* intended to be magnetized. He afterwards took the two magnets N′S′, and inclining them as in the method of Æpinus, he placed them firſt on the middle of the needle, or with their poles nearly in contact. He then drew each magnet, without changing its inclination, to the extremity of the needle, and repeated this operation 5 or 6 times on each face of the needle. It is clear, that in this operation the poles of the needle *n s* remain fixed and invariable at the extremities of the needle, by means of the two ſtrong magnets NS on which it reſts. The effect produced by theſe can only be augmented by the action of the two ſuperior magnets, which concur in magnetizing all the particles of the needle in the ſame direction.

He found likewiſe, that in this method of magnetizing there is a greater certainty of giving to both ſurfaces of needles intended to determine the magnetic meridian, an equal degree of magnetiſm; a circumſtance deſerving of the greateſt attention in the conſtruction of compaſſes, if the needle be ſuſpended with its broadeſt ſurface parallel to the horizon.

After theſe previous proceſſes, he took 30 bars of ſteel hardened and tempered to the temper of a ſpring, five or ſix lines broad, two or three lines thick, and 36 inches long. The blades of fencing foils, ſuch as are found in the ſhops, make pretty good magnets. Engliſh ſheet ſteel cut into pieces one inch wide, hardened and lowered to ſpring temper, is preferable. When each compound magnet is to contain no more than 15 or 20 pounds of ſteel, it is ſufficient to make the bars 30 or 36 inches long.

He magnetized each bar ſingly, according to the method already deſcribed. He then took two rectangular parallelopipedons of very ſoft iron, well poliſhed, ſix inches in lengh, between 20 and 24 lines broad, and 10 or 12 lines thick. With theſe two parallelopipedons, repreſented fig. 20. at N and S, he formed the armour of his magnet by enveloping one extremity of each parallelopipedon with a ſtratum of his magnetic bars, ſo that the extremities of the parallelopipedons may project beyond the extremities of the bars 20 or 24 lines, and the other end may be enveloped by the ends of the ſet of bars. On this firſt layer of ſteel bars of three or four lines thick he places a ſecond, three inches ſhorter than the firſt, ſo that the firſt projects beyond the ſecond about 18 lines on each ſide. The whole is ſecured at the ends by two binding pieces of copper, which preſs the bars cloſe together, and prevent the armour from eſcaping.

Fig. 20. repreſents two artificial magnets compoſed according to the method juſt deſcribed. N and S are the extremities of the two iron parallelopipedons. The two other extremities are incloſed by the bars. Each magnet thus compounded is ſolidly connected together by the copper pieces marked *a*, *b*, *a′*, *b′*. The pieces of contact A, R, join the oppoſite poles of the magnets.

He found by experience, that with an apparatus of this form, each part weighing 15 or 20lbs. a force of 80 or 100lb. will be required to ſeparate the pieces of contact; and that when an ordinary needle of the compaſs is placed on the two extremities of the compound bars, fig. 20. they become magnetized to ſaturation, without being rubbed with the upper pair. When magnets of greater force are deſired, it is neceſſary, in proportion as the number of bars is increaſed, to augment their length alſo, and the dimenſions of the parallelopipedons of iron which ſerve for the armour. It would be eaſy to aſcertain the different dimenſions which the magnets ought to have, in a manner ſufficiently accurate for practice, from the laws of magnetiſm, and the poſition of the centre of action of the bars of ſteel of different lengths and thickneſs.

58 Iron or ſteel becomes magnetic by poſition.

2. *Iron or ſteel is rendered magnetical by being placed in a poſition correſponding to the magnetic meridian.*

It has been often obſerved, that a bar of iron which has ſtood for a long time exactly or nearly in the magnetic direction, has acquired a degree of magnetic power, the extremities poſſeſſing oppoſite polarity. In this and other northern parts of Europe, old vanes of turrets, window bars, and even pokers that have ſtood long inclined in the chimney corner, are often very ſenſibly magnetic, their lower extremity becoming a north, and the upper a ſouth pole. In the higheſt part of the ſteeple of St Giles's church in Edinburgh, on the north ſide, the upper bar of a hand-rail leading to a ſtair is very magnetical. It is worthy of remark, that thoſe parts of ſuch old bars which have become foliated and crumbly by expoſure to the air are the moſt magnetical. This magnetic ſtate of perpendicular iron bars was, as we are informed by Dr Gilbert, firſt obſerved in the vane ſpindle of the Auguſtine church at Mantua.

59 By hammering or friction.

3. *A bar of ſteel long hammered or expoſed to violent friction, while lying in the magnetic meridian, becomes magnetic.*

This fact was well known to Dr Gilbert, who in a plate repreſents a blackſmith hammering a bar of ſteel in the magnetic poſition. Many ſmiths tools, ſuch as long drills, that receive great preſſure while in motion, broaches that are worked with a long lever, ſo as to act very faſt, become very ſenſibly magnetical; the lower end, in theſe latitudes, being always a north pole. When a ſteel punch is driven hard into a piece of iron, the punch has ſometimes been rendered magnetical by a ſingle blow. There is ſcarcely a cutting or boring tool in a ſmith's ſhop that does not poſſeſs ſome degree of magnetic power. Even ſoft ſteel and iron will acquire it by being violently twiſted or expoſed to great friction, and the magnetiſm thus acquired

Experimental Illustrations.

quired is commonly permanent. From this circumstance it is difficult to procure for nice experiments pieces of iron that do not possess some degree of magnetism, and hence these experiments do not always succeed. It is therefore convenient to know how to deprive iron and steel of magnetism, and the method of doing this will appear from what will be said in the next section.

The steel balances of watches are often magnetic, sometimes even shewing evident polarity; a circumstance which is found to have some effect in disturbing the proper going of such watches or time-pieces. Hence it is recommended to make the balances of brass. See a paper on this subject by Mr Varley, in the first volume of the Philosophical Magazine.

4. *Magnetism may be induced on substances that are susceptible of it, by heat.*

60 By heat.

Dr Gilbert remarks that such ores of iron as are in that particular metallic state, which he considers as most susceptible of magnetism, will acquire this power by being kept long in a red heat, while in a magnetic direction; and that their polarity corresponds to their position, that end of the mass which is opposite the north becoming a north pole. By many experiments made both by Dr Gilbert, and since his time by Dr Hock, on iron and steel bars, it appears that these acquire permanent magnetism by being exposed to a strong heat, and suffered to cool gradually while lying in the magnetic direction; but that the magnetism thus acquired by steel rods is much stronger and more durable, if they are suddenly quenched with cold water, so as to give them a very hard temper. Dr Hooke found that the end of the bar next the north, or the lower end of a vertical bar, always became its permanent north pole, and the upper end, even when quenched, while the rest was suffered to cool gradually, became a very sensible south pole. If these operations were performed on bars placed in a position at right angles to the magnetic direction, no magnetism was acquired. Dr Gilbert makes a remarkable observation respecting the position of a magnetic needle brought near an ignited bar of iron, which was some years ago repeated in the Philosophical Transactions as a new discovery. "*Bacillum ferreum, validè ignitum appone versorio excito: stat versorium, nec ad tale ferrum convertitur: sed statim ut primum de candore aliquantulum remiserit, consluit illico.*" Thus it appears that iron is not susceptible of magnetism when red-hot, but that it acquires magnetic power during its cooling. Dr Gilbert ascertained the degree of heat most favourable to the production of magnetism, but from his want of proper thermometers he did not succeed. Dr Robison found that though a bright red or a white heat does not make iron susceptible of magnetism while it is exposed to such a heat, it predisposes it for becoming magnetical. He found that when a bar of steel was made to acquire magnetism by being tempered in the magnetic direction, the acquired magnetism was much stronger when the bar was first made very hot, even though allowed to acquire its most magnetical state before being quenched, than if it had been heated only to this latter degree. Nay, he always found it stronger if quenched while red hot.

He also found that when he heated a small steel bar red-hot, and quenched it while lying between two magnets, it acquired a much stronger magnetic power than it would acquire in any other way.

Mr Canton contrived the following method of producing magnetism in steel bars, without the assistance either of natural or artificial magnets. 61

Canton's method of making artifical magnets.

Take twelve bars, six of soft, and six of hard steel, the former three inches long, one-fourth of an inch broad, and one-twentieth of an inch thick; with two pieces of iron, each half the length of one of the bars, but of the same breadth and thickness. The six hard bars should be each five inches and a half long, one-half inch broad, and three-twentieths of an inch thick, with two pieces of iron of half the length, but of the same breadth and thickness as one of the hard bars; and let all the bars be marked with a line quite round them at one end; then take an iron poker and tongs, or two bars of iron, the larger they are, and the longer they have been used, the better; and fixing the poker upright, or rather in the magnetical line between the knees, hold to it, near the top, one of the soft bars, having its marked end downwards, by a piece of sewing silk, which must be pulled tight by the left hand, that the bar may not slide; then grasping the tongs with the right hand, a little below the middle, and holding them nearly in a vertical position, let the bar be stroked by the lower end from the bottom to the top about ten times on each side, which will give it a magnetic power sufficient to lift a small key at the marked end; which end, if the bar were suspended on a point, would turn towards the north, and is therefore called the north pole, and the unmarked end, for the same reason is called the south pole. Four of the soft bars being impregnated after this manner, lay the other two parallel to each other, at a quarter of an inch distant, between the two pieces of iron belonging to them, a north and a south pole against each piece of iron; then take two of the bars already made magnetical, and place them together so as to make a double bar in thickness, the north pole of the one even with the south pole of the other, and the remaining two being put to these, one on each side, so as to have two north and two south poles together, separate the north from the south poles at one end by the interposition of some hard substance (I, fig. 21.), and place them perpendicularly with that end downward on the middle of one of the parallel bars AC, the two north poles towards its south end, and the two south poles towards its north end. Slide them three or four times backward and forward the whole length of the bar; then removing them from the middle of this bar, place them on the middle of the other bar BD as before directed, and go over that in the same manner; then turn both bars the other side upwards, and repeat the former operation: this being done, take the two bars from between the pieces of iron, and placing the two outermost of the touching bars in their stead, let the other two be the outermost of the four to touch these with; and this process being repeated till each pair of bars have been touched three or four times over, will give them a considerable magnetic power.

When the small bars have been thus rendered magnetic, in order to communicate the magnetism to the large bars, lay two of them on the table, between their iron conductors as before; then form a compound magnet with the six small bars, placing three of them with the

Experimental Illustrations.

the north poles downwards, and the three others with the fouth poles downwards. Place the two parcels at an angle, as was done with four of them, the north extremity of the one parcel being put contiguous to the fouth extremity of the other, and with this compound magnet ftroke four of the large bars, one after another, about twenty times on each fide, by which means they will acquire fome magnetic power.

When the four large bars have been fo far rendered magnetic, the fmall bars are laid afide, and the large ones are ftrengthened by themfelves, in the manner followed with the fmall bars.

To expedite the operation, the bars ought to be fixed in a groove, or between brafs pins, otherwife the attraction and friction between the bars will be continually deranging them when placed between the conductors.

This whole procefs may be gone through in about half an hour, and each of the large bars, if well hardened, will lift about 28 ounces troy, and they are fitted for all the purpofes of magnetifm in navigation and experimental philofophy. The half dozen being put into a cafe in fuch a manner as that no two poles of the fame name may be together, and their irons with them as one bar, they will retain the virtue they have received; but if their power fhould, by making experiments, be ever fo much impaired, it may be reftored without any foreign affiftance in a few minutes.

Thefe bars muft be kept in a wooden box, arranged in fuch a manner that their oppofite poles may lie together, as reprefented at fig. 22.

62 Marcel's method.

There are various methods of communicating a permanent magnetifm to ferruginous bodies, by means of a bar rendered magnetic, by pofition, of which the moft fimple is that defcribed by Mr Marcel, whofe experiments were made in the year 1726. Being employed in making fome obfervations on the magnetic power which he found in great pieces of iron, he took a large vice weighing 90 pounds, in which he fixed a large anvil weighing 12lbs. The fteel to which he wifhed to give the magnetic power was laid upon the anvil in a north and fouth pofition, which happened to be the diagonal of the fquare furface of the latter. He then took a four cornered piece of iron an inch thick every way, 33 inches long, weighing about 8lbs. having one end rounded and brightly polifhed, the other being tapered. Holding then the fteel faft upon the anvil with the one hand, he took the iron bar in the other, and holding it perpendicularly, he rubbed the fteel hard with the rounded part towards him from north to fouth, always carrying the bar far enough round about to begin at the north. Having thus given 10 or 12 ftrokes, the fteel was turned upfide down, and rubbed as much on the other fide. Proceeding in this manner till it had been rubbed 400 times, the fteel was as ftrongly magnetic as if it had been touched by a powerful loadftone. The place where he began to rub was always the north pole. In thefe experiments it fometimes happened that the virtue was imparted by a few ftrokes; nay, by a fingle ftroke a fmall needle was made to receive a very confiderable power. Thus he imparted to two compafs needles fuch a degree of magnetic power, that one lifted three-fourths, and another a whole ounce of iron, and although thefe needles were anointed with lintfeed oil to keep them from rufting, and a hard coat was thus formed upon them, they neverthelefs retained their power. Thus alfo a knife was made fo ftrongly magnetical, that it would take up an ounce and three-fourths of iron. Four fmall pieces of fteel, each an inch long, and one-twelfth of an inch broad, as thin as the fpring of a watch, were thus impregnated with the magnetic power, and then joined into a fmall artificial magnet; which at its firft formation took up eight times its own weight of iron; and after being fix years kept in the moft carelefs manner, was found to have gained rather than loft any thing of its power. In the courfe of his experiments, Mr Marcel found, that the end at which he began to rub was always the north pole, whatever pofition the fteel was laid in. On rubbing a piece of fteel from one end to the middle, and then from the other end to the middle, it acquired two north poles, one at each end, the middle being a fouth pole. Beginning to rub from the middle towards each end, he found a north pole in the middle, and a fouth pole at each extremity.

63 Method of magnetizing a piece of foft fteel.

Magnetifm may be communicated to a fmall piece of foft fteel in the following manner: take two iron bars of about an inch fquare, and upwards of three feet in length; keep them in the magnetical line, or in a perpendicular pofture, as reprefented fig. 23. Let the piece of fteel CB be either faftened to the edge of a table, or held by an affiftant; and placing the lower extremity of the bar AB, and the upper extremity of the bar CD, on oppofite fides, and in the middle of the fteel, ftroke the latter from the middle towards its extremities, moving both bars at the fame time. When both are arrived at the extremities of the fteel, remove them from it, and apply them again to the middle. Do fo for 40 or 50 times, and the fteel will be found to have a confiderable degree of magnetic power. Care, however, muft be taken, in removing the bars, not to draw them along the furface of the fteel, or the experiment will not fucceed, becaufe the magnetifm is deftroyed by the contrary ftrokes.

64 Dr Knight's artificial loadftones.

The late Dr Gowin Knight poffeffed a furprifing fkill in magnetifm, being able to communicate an extraordinary degree of attractive or repulfive power, and to alter or reverfe the poles at pleafure; but as he refufed to difcover his methods upon any terms whatever (even as he faid, though he fhould receive in return as many guineas as he could carry), thefe curious and valuable fecrets have died with him. In the 69th volume of the Philofophical Tranfactions, however, Mr Benjamin Wilfon has given a procefs, which at leaft difcovers one of the leading principles of Dr Knight's art, and may perhaps be a means of difcovering the whole to thofe who fhall be lefs referved. The doctor's procefs, according to Mr Wilfon, was as follows. Having provided himfelf with a great quantity of clean iron filings, he put them into a large tub, that was more than one-third filled with clean water; he then, with great labour, worked the tub to and fro for many hours together, that the friction between the grains of iron by this treatment might break off fuch fmaller parts as would remain fufpended in the water for a time. The obtaining of thefe very fmall particles in fufficient quantity feemed to him to be one of the principal defiderata in the experiment. The water being by this treatment rendered very muddy, he poured the fame into a clean iron veffel, leaving the filings behind;

Experimental Illustrations.

hind; and when the water had ſtood long enough to be clear, he poured it out carefully, without diſturbing ſuch of the ſediment as ſtill remained; which now appeared reduced almoſt to an impalpable powder. This powder was afterwards removed into another veſſel in order to dry it; but as he had not obtained a proper quantity thereof by this one ſtep, he was obliged to repeat the proceſs many times. Having at laſt procured enough of this very fine powder, the next thing was to make a paſte of it, and that with ſome vehicle which would contain a conſiderable quantity of the inflammable matter; for this purpoſe he had recourſe to lintſeed oil in preference to all other fluids. With theſe two ingredients only he made a ſtiff paſte, and took particular care to knead it well before he moulded it into convenient ſhapes. Sometimes, while the paſte continued in its ſoft ſtate, he would put the impreſſion of a ſeal upon the ſeveral pieces; one of which is in the Britiſh Muſæum. This paſte was then put upon wood, and ſometimes on tiles, in order to bake or dry it before a moderate fire, at about the diſtance of a foot. He found that a moderate fire was moſt proper, becauſe a greater degree of heat made the compoſition frequently crack in many places. The time required for the baking or drying of this paſte was generally about five or ſix hours before it attained a ſufficient degree of hardneſs. When that was done, and the ſeveral baked pieces were become cold, he gave them their magnetic power in any direction he pleaſed, by placing them between the extreme ends of his large magazine of artificial magnets for a few ſeconds or more as he ſaw occaſion. By this method the power they acquired was ſuch, that when any of theſe pieces were held between two of his beſt ten guinea bars, with its poles purpoſely inverted, it immediately of itſelf turned about to recover its natural direction, which the force of thoſe very powerful bars was not ſufficient to counteract.

In the 66th volume of the Philoſophical Tranſactions we have the following account from Dr Fothergill, of Dr Knight's method of imitating natural magnets, but which is by Mr Cavallo ſuppoſed to be ſome miſtake or miſinformation. "I do not know, ſays he," that ever the doctor (Dr Knight) left behind him any deſcription of a compoſition he had made to form artificial loadſtones. I have ſeen in his poſſeſſion, and many other of his friends have likewiſe ſeen, ſuch a compoſition, which retained the magnetic virtue in a manner much more fixed than either any real loadſtone, or any magnetic bar, however well tempered. In the natural ones he could change the poles in an inſtant, ſo likewiſe in the hardeſt bars, but in the compoſition the poles were immoveable. He had ſeveral ſmall pieces of this compoſition which had ſtrong magnetic powers. The largeſt was about half an inch in breadth, very little longer than broad, and near one-fourth of an inch thick. It was not armed, but the ends were powerfully magnetic; nor could the poles be altered, though it was placed between two of his largeſt bars, and they were very ſtrongly impregnated. The maſs was not very heavy, and had much the appearance of a piece of black lead, though not quite ſo ſhining. I believe he never divulged the compoſition, but I think he once told me, the baſis of it was filings of iron reduced by long-continued attrition to a perfectly impalpable ſtate, and then incorporated with ſome pliant matter to give it due conſiſtence."

From theſe accounts it appears that the baſis of Dr Knight's artificial loadſtones was the black powder to which iron filings are reduced by being ſhaken with water, or the *black oxide of iron*, formerly called martial æthiops. Hence Mr Cavallo ſuppoſes that the following receipt for imitating the natural magnets will anſwer the purpoſe.

Take ſome martial æthiops, reduced into a very fine powder, or, which is more eaſily procured, *black oxide of iron*, the ſcales which fall from red-hot iron when hammered, and are found abundantly in ſmiths ſhops. Mix this powder with drying lintſeed oil, ſo as to form it into a very ſtiff paſte, and ſhape it in a mould ſo as to give it any form you require, whether of a terrella, a human head, or any other. This done, put it into a warm place for ſome weeks, and it will dry ſo as to become very hard; then render it magnetic by the application of powerful magnets, and it will acquire a conſiderable power.

SECT. IV. *Of the Circumſtances which tend to impair or deſtroy the Magnetic Power.*

65 Magnetiſm loſt or deſtroyed

The magnetic power in all its modifications, whether of attraction, repulſion, or polarity, is in general temporary and periſhing. The beſt magnets, whether natural or artificial, unleſs carefully preſerved, with attention to certain circumſtances that will preſently appear, are obſerved to have their magnetic power diminiſhed. Natural magnets, and artificial magnets made of ſteel tempered as hard as poſſible, retain their power moſt obſtinately, and ſeldom entirely loſe it except under circumſtances which we know to be unfavourable to its durability. Magnets of ſteel of a ſpring temper, are much ſooner weakened, loſe more of their force merely by keeping, and finally retain little or none of it. Soft ſteel and iron ſeldom retain magnetic power when removed from the magnet where they acquired it, unleſs their metallic ſtate undergoes ſome change.

The following circumſtances have been obſerved to be moſt powerful in diminiſhing or deſtroying the power of magnets.

66 By improper poſition;

1. *Improper poſition.* Nothing has ſo much effect in impairing the power of a magnet as keeping it in an improper poſition, that is, too far from the magnetic line. If the axis of the magnet be placed in a direction that is at right angles with the magnetic meridian, that is, in this latitude nearly E. N. E. and W. N. W, it will ſooneſt loſe its magnetic power; and if it be placed in the magnetic line, but in a contrary poſition, or with the north pole where the ſouth pole ſhould be, if permitted to vibrate freely, it will gradually become weaker every day, and unleſs it be a natural magnet, or an artificial one made of very hard tempered ſteel, it will, in no very long time, entirely loſe its magnetic power.

67 By heat;

2. *Heat.* The diſſipation of magnetic power is greatly promoted by heating the magnet. The heat of boiling water has a ſenſible effect in this way; but if the magnet be expoſed to a red heat, its power is entirely deſtroyed, as has been long known. Dr Gilbert obſerved that the power of magnets was deſtroyed by a heat

Theory.

heat that was not sufficient to make the metal visible in the dark; and Mr Canton found that the heat of boiling water weakened the power of a magnet, but that the greatest part of this was recovered as the magnet cooled. If the heat be applied when the magnet lies in a position most favourable to the dissipation of magnetism, the power is soonest destroyed; hence, the best way to deprive iron or steel of accidental magnetism is, to heat it red-hot, and allow it to cool while lying in a direction perpendicular to the magnetic line.

M. Coulomb has ascertained that at 200 degrees of heat, two fifths of the magnetism of a magnet is dissipated, and that at 500 degrees the whole is lost.

68 By violent treatment; 3. *By violent treatment.* It is very extraordinary that the power of a magnet is impaired by rough usage. Dr Gilbert observed that a magnet which he had powerfully impregnated was greatly weakened by a single fall on the floor; and since his time it has been observed that when a magnet falls on a stone, or receives any concussion that makes it ring, it is injured much more than by being beaten with any thing soft and yielding. When a natural magnet is ground with coarse powders, in order to bring it to any required form, it is considerably weakened. This shews the propriety of altering the natural form of loadstones as little as possible, and where this is necessary, of doing it as expeditiously as may be, by cutting them briskly in the thin disks of a lapidary's wheel.

69 By similar poles being opposite. 4. *Placing them near each other with their similar poles opposite.* Magnets situated in this way always weaken each other, and when a powerful magnet is placed near a weaker, with their similar poles opposed, the polarity of the weaker is frequently reversed, that is, if the pole were north it becomes south, and *vice versa.* When the weaker magnet is a natural loadstone, or has been made of hard tempered steel, its original polarity is restored when the improper position is changed; but if it has been made of spring-tempered steel, the alteration is generally permanent, and often as complete as while the magnets were in the neighbourhood of each other.

Chap. III. *Theory of Magnetism.*

70 Opinions of the ancients. Respecting the notions which the ancient philosophers entertained about the cause of magnetic phenomena, we know very little. One curious opinion which they entertained of the reason why a magnet was improved by the contact of iron, is worth noticing. They conceived that the magnet *fed upon the iron,* and hence acquired additional attractive power; and when deprived of this pabulum, it grew weak and languid.

—— " Nam ferro nurunt vitam, ferrique vigore
Vescitur; hoc dulces epulas, hoc pabula novit;
Hinc proprias renovat vires, hinc fusa per artus
Aspera secretum servant alimenta vigorem.
Hoc absente perit, tristi morientia torpent
Membra fame, venasque sitis consumit apertas."

Claudian.

In the 16th century, the philosophers of modern times first began to speculate about the cause of magnetic polarity, a phenomenon which then became interesting on account of the difference of declination observed by navigators. Various trifling opinions were published on the subject. Some said that the needle was directed by a certain point in the heavens, which was little more than saying that it pointed one way. Others ascribed the direction of the needle to vast magnetic rocks situated in the earth; but as to the exact situation of these rocks, they did not give themselves the trouble to inquire, till Fracastori observed, that, if those rocks are supposed to be situated in any part of the globe yet visited by navigators, and if, as we must suppose, they act like loadstones, they will cause the direction to be very different from what is observed. He therefore placed them somewhere in the inaccessible polar regions, though not immediately at the poles. Norman, who, as we have seen (*Dipping Needle*), discovered the dip of the magnetic needle, and observed that in every part of Europe, the north pole pointed very far below the horizon, was naturally led to ascribe this effect to the influence of the earth, though he does not express himself as if he thought that the needle was attracted by any point within the earth, but only that it was always directed to such a point.

71 Gilbert's theory. From comparing the different positions of the compass needle, as described by Norman, with the positions which he had himself observed small needles to assume in relation to a magnet, Dr Gilbert was naturally led to consider the earth as a great loadstone, or else containing a great loadstone within it, which arranged the dipping needle, or the needle of the compass, in the same manner as he observed a small needle poised on its pivot, to be arranged by a large magnet. Dr Gilbert has explained his theory at large in his *Physiologia Nova de Magnete, et de Tellure Magno Magnete.* It may be briefly expressed in the following terms. All the appearances of natural magnetism are similar to what would be observed in the earth, were a large magnet with its poles situated near the poles of the equator, viz. the north pole not far from Baffin's bay in North America, and the south pole in about the opposite part of the globe. If a dipping needle were exposed to the influence of such a large magnet, it must arrange itself in a plane passing through the magnetic poles, a position indicated very nearly by the mariners needle; and the more we recede from the equator of the great magnet, the more must the dipping needle be inclined to the horizon.

Dr Gilbert's theory was equally ingenious and important, and affords, if firmly established, a complete explanation of all the phenomena of magnetism. At the time it was first published, however, observations were neither sufficiently numerous, nor sufficiently accurate, to enable the author to assign the real position of the great magnet, nor to ascertain its laws of action. The theory was chiefly founded on observations made by the dipping needle, and though those instruments made by Norman were more accurate than might have been expected at so early a period of the science, the observations made with them cannot, from many circumstances, be implicitly relied on. We are still in want of a numerous collection of observations on the dip, in order to perfect our knowledge of the magnetic poles. We can only say that the earth acts on the compass needle in the same manner as a large magnet would act; but the appearances do not seem to resemble the effects of what we should consider as a good loadstone having two vigorous 72

Theory.

gorous poles, but rather ſuch as would reſult from the action of a very irregular loadſtone with its poles very much diffuſed.

73 It is unfortunate that our moſt numerous obſervations of the dip have not been made in thoſe places where they would be the moſt inſtructive. Dr Robiſon was of opinion that a ſeries of obſervations ſhould be obtained, extending from New Zealand northward, acroſs the Pacific ocean to Cape Fairweather on the weſtern coaſt of North America, whence it ſhould be continued through that part of the continent. A ſecond ſeries might extend from the Cape of Good Hope along the weſtern coaſt of Africa to the tropic of Capricorn; thence acroſs the interior of the African continent through Sicily, Italy, Dalmatia, the eaſtern part of Germany, the gulf of Bothnia, Lapland, and the weſtern part of Greenland. This ſeries would be nearly in a plane paſſing through the probable ſituations of the poles. A third ſeries might extend at right angles to the laſt, ſo as to form a ſmall circle croſſing the former, paſſing near Japan, through the iſland of Borneo, and the weſtern part of New Holland; near Mexico, and a few degrees weſt of Eaſter iſland. Here and at Borneo there would be a conſiderable inclination of the magnetic plane to the horizon, though this cannot be found out. There are, however, other points of this circle in which the dip is conſiderable, where the inclination may be diſcovered. In ſhort, all circumſtances ſeem to indicate a multiplicity of poles, or what renders calculation moſt difficult, an irregular magnetiſm in which the polarity is very much diffuſed.

Philoſophers are very much divided reſpecting the ſituation of the magnetic poles of the earth. We ſhall here ſtate only a few of their opinions, reſerving a fuller account of ſome of them for the article *Variation of the Compaſs*.

74 Opinions as to the ſituation of the magnetic poles.

Dr Halley thought that the north magnetic pole was near Baffin's bay in North America.

Profeſſor Krafft (ſee Peterſburgh Comment. vol. xvii.) places the north pole in N. Lat. 70° and W. Long. 23° from London; and the ſouth pole S. Lat. 50°, and E. Long. 92°.

Wilcke of Stockholm places the north pole in N. Lat. 75° near Baffin's bay, and in the longitude of California, while he fixes the ſouth pole in S. Lat. 70° in the Pacific ocean.

Churchman ſuppoſes the north pole to be in N. Lat. 59°, and W. Long. 135°, a little inland from Cape Fairweather; and the ſouth in S. Lat. 59°, and E. Long. 165°, directly ſouth of New Zealand. (See Variation).

Euler (Memoirs of the Acad. of Berlin, vol. xvi.) places the north pole in N. Lat. 75°. Lemounier (*Lois du Magnetiſme*) in N. Lat. 73°. Buffon in N. Lat. 71°.

La Lande places it in N. Lat. 77° 4′, and in about W. Long. 98° from Paris. (See *Connoiſſance des Tems*, an. xii.).

However ingenious this hypotheſis of Dr Gilbert was, it appears to have been nothing more than a ſagacious conjecture. The hypotheſis, however, is confirmed into a rational theory by many obſervations and experiments which were unknown or unthought of in Dr Gilbert's time.

75 Proofs of the truth of the theory.

Mr Hindſhaw's beautiful experiment on the effect of an upright iron bar on the oppoſite ends of a compaſs-needle, according as one end or the other of the bar is next the earth (ſee *Variation of the Compaſs*) is an abundant proof of the juſtneſs of this theory.

We can imitate that experiment in a very ſatisfactory manner by artificial magnetiſm; thus forming a juſt compariſon between the action of the earth and that of a magnet.

Let a large bar magnet, as SAN (fig. 24.) be ſupported ſo as to have its ends detached from ſurrounding bodies. Then place a ſmall needle nicely poiſed, as B, about three inches below N, the north pole of the magnet, and ſo that its directive power for the magnet may be very weak. Now take a ſmall piece of ſoft iron and hold it in ſuch a poſition as is repreſented at C; its lower end becoming a north pole will attract the ſouth pole of the needle. Now, while the needle is kept in the ſame poſition, turn round the piece of iron into the poſition D; the ſouth pole of the needle will be ſeen to avoid it, and the north pole will be attracted. Here the magnet may be compared to the earth, and the ſmall piece of iron to the iron bar in Mr Hindſhaw's experiment.

Again, it has been ſeen that magnetiſm may be produced in iron or ſteel by hammering or heating them while in a determinate poſition with reſpect to the earth. The ſame effect will be produced by the ſame proceſſes while the iron or ſteel is in the neighbourhood of a powerful magnet.

Laſtly, the circumſtance of the magnetic inclination of the north pole of the dipping needle being diminiſhed, and the horizontality of the compaſs needle deſtroyed, as we aſcend above the earth, is an additional and certain evidence of the truth of this theory.

In ſhort, we may conſider it as demonſtrated, that the earth is a great magnet, or contains a great magnet, by the influence of which the direction of the needle and all the magnetic power acquired by iron, when placed in a proper poſition, are produced.

A further illuſtration and application of this theory will be given preſently, when we have conſidered ſome other hypotheſes poſterior to that of Dr Gilbert.

76 Theories of impulſion.

It was very early an object with philoſophers to aſſign the immediate cauſe of magnetic attraction and repulſion, and of that faculty of mutual impregnation which ſo remarkably diſtinguiſhes iron from all other ſubſtances. In particular, the curious arrangement of iron filings ſtrewed round a magnet forcibly attracted their attention. It is ſcarcely poſſible to obſerve this arrangement without conceiving the idea of a ſtream of matter iſſuing from one of the poles of the magnet, moving round it, entering by the other pole, and again iſſuing by its former outlet. Accordingly, ſuch an idea was entertained in the earlieſt times; but very different notions prevailed as to the manner in which ſuch a ſtream produced the effects obſerved. One of the ſimpleſt methods was, to conceive it acting by impulſion, like any other ſtream of fluid matter. This idea was entertained by Lucretius, who ſuppoſed the ſurrounding air to be ſwept out of the way by the impulſion of the fluid, which thus ruſhing round the magnet carried the iron filings towards it.

77 Euler's hypotheſis.

In the laſt century Euler framed an hypotheſis of magnetiſm on this theory of impulſion. He ſuppoſes, that the two principal cauſes which concur in producing the

Theory.

the wonderful properties of a magnet, are. First, A particular ſtructure of the internal pores of the magnets, and of magnetical bodies; and, Secondly, An external agent or fluid, which acts upon, and paſſes through theſe pores. This fluid he ſuppoſes to be the ſolar atmoſphere, or that ſubtile matter called *ether*, which fills our ſyſtem.

Indeed, moſt writers on this ſubject agreed in ſuppoſing that there are corpuſcles of a peculiar form and energy, which continually circulate around and through a magnet; and that a vortex of the ſame kind circulates around and through the earth.

"A magnet, beſides the pores which it has in common with other bodies, has alſo other pores conſiderably ſmaller, deſtined only for the paſſage of the magnetic fluid. Theſe pores are ſo diſpoſed as to communicate one with the other, forming tubes or channels, by which the magnetic fluid paſſes from one end to the other. The pores are ſo formed, that this fluid can only paſs through them in one direction, but cannot return back the ſame way; ſimilar to the veins and lymphatic veſſels of the animal body, which are furniſhed with valves for this purpoſe: So that the pores of the magnet may be conceived to be formed into ſeveral narrow contiguous tubes, parallel to each other, as at A, B, fig. 25. through which the finer part of the ether paſſes freely from A to B, but cannot return back on account of the reſiſtance it meets with at *a*, *a*, *b*, *b*, nor overcome the reſiſtance of the groſſer ether, which occaſions and continues the motion. For ſuppoſing the pole A of a magnet, filled with ſeveral mouths or open ends of ſimilar tubes, the magnetic fluid, preſſed by the groſſer parts of the ether, will paſs towards B with an inconceiveable rapidity, which is proportionable to the elaſticity of the ether itſelf; this matter which, till it arrives at B, is ſeparated from the tubes by the groſſer parts, then meets with it again, and has its velocity retarded, and its direction changed; the ſtream, reflected by the ether, with which it cannot immediately mix, is bent on both ſides towards C and D, and deſcribes, but with leſs velocity, the curves DE and C F *e*, and approaching by the curves *d* and *c*, falls in with the effluent matter *m m*, and again enters the magnet; and thus forms that remarkable atmoſphere, which is viſible in the arrangement of ſteel filings on a piece of paper that is placed over a magnet" †.

† *Lettres à une Princeſſe d'Allemagne.*

78 We have already had occaſion (ſee the article IMPULSION) to make ſome obſervations on the general doctrine of impulſion, and theſe need not be here repeated. Reſpecting the explanations afforded by the canals and dock-gates in Euler's hypotheſis, opening in one direction and ſhutting in the other, we may obſerve, that as theſe conſtructions are altered in a moment in a bar of ſoft iron, merely by changing the poſition of the magnet, it is aſtoniſhing that they ſhould ever have been conceived by ſo acute a philoſopher. Even ſuppoſing ſuch circumſtances to take place, the effects reſulting from them ſhould be the reverſe of what are actually obſerved, as the impelling ſtream ſhould move thoſe bodies leaſt which afford the readieſt channels for its paſſage. If the iron filings were arranged by this impelling ſtream, they ſhould be carried along with it, and if they are carried towards one pole of the magnet, they ſhould be driven away from the other.

Theory. 79 Theory of Æpinus.

Æpinus, of the academy of Peterſburgh, whoſe theory of electricity we have explained and illuſtrated at conſiderable length, was led by the analogy obſerved between the phenomena of electricity and thoſe of magnetiſm, and in particular from the reſemblance between the attractions and repulſions of the tourmalin and thoſe of a magnet, to conceive the idea that both claſſes of phenomena might be explained in a ſimilar manner, or that the phenomena of magnetiſm, like thoſe of electricity, were to be attributed to the motions of a certain fluid exiſting in all bodies ſuſceptible of magnetiſm. This conjecture was confirmed by obſerving, that when magnetiſm was induced on a piece of iron by its proximity to a magnet, the power of the magnet is not ſenſibly diminiſhed. The following is an abſtract of Mr Æpinus's hypotheſis.

1. There exiſts in all magnetic bodies a ſubſtance which may be called the magnetic fluid, the particles of which repel each other with a force that decreaſes as the diſtance increaſes.

2. There is a mutual attraction, varying according to the ſame law, between the particles of the magnetic fluid, and the particles of iron.

3. There is a mutual repulſion among the particles of iron, following the ſame law.

4. The magnetic fluid is capable of moving through the pores of iron, and ſoft ſteel, without any conſiderable difficulty: but its motion is more and more obſtructed as the ſteel receives a harder degree of temper; and in ſteel of the hardeſt temper, and the ores of iron, it moves with the greateſt difficulty.

5. From the ſuppoſed attraction between the magnetic fluid and iron, the latter may contain a certain determinate quantity of the former, and this quantity will be ſuch that the accumulating attraction of a particle of it for the whole of the iron, balances the repulſion between the particles of the whole fluid contained in the iron; ſuppoſing the quantity of fluid competent to a particle of iron to be ſuch, that the repulſion between it and the fluid competent to another particle of iron, is alſo equal to its attraction for that particle of iron. Therefore the attraction between the fluid in one iron bar A, and the iron of another bar B, is juſt equal to the repulſion between the iron in A and the iron in B. This determinate quantity of fluid in the iron is called its *natural quantity*.

6. From the mobility of the fluid through the pores of iron, it may, by the agency of a proper external force, be abſtracted from one end of an iron bar, and condenſed in the other end. This, however, is a violent ſtate, and the mutual repulſion between the particles of condenſed fluid, together with the attraction between the fluid and that part of the iron which it has quitted, tend to produce a more uniform diſtribution. It is evident that ſomething of this tendency muſt take place in every ſtate of condenſation and rarefaction, and that a perfect equilibrium can be produced only when the fluid is diffuſed with perfect uniformity. This ſtate of uniformity may be called the natural ſtate of the body.

7. The production of ſuch a uniform diſtribution will depend on the nature of the reſiſtance to the motion of the fluid, oppoſed by the iron in its various ſtates. If this reſiſtance ariſes merely from the communication of motion, like that which perfect fluids oppoſe to the motion

Theory.

tion of ſolid bodies, ſuch reſiſtance may be overcome by the weakeſt tendency to uniform diffuſion; but if, as ſeems moſt likely, the obſtruction is like that of a clammy fluid, or of a ſoft plaſtic body like clay, after the accumulation ariſing from the action of an external force, it may remain after that force is removed; and the diffuſion will ceaſe when there is a perfect equilibrium between the obſtruction and the diffuſing force.

As the illuſtration of this theory in general caſes is preciſely ſimilar, *mutatis mutandis*, with that of electricity, ſo fully detailed under the article ELECTRICITY, from N° 299 to 348, we need not repeat it here, but may refer the reader to that treatiſe, requeſting him to conſider the illuſtration as relating to the *magnetic* fluid.

It is proper, however, to remark here, that the phenomena of magnetiſm are limited by this circumſtance; that magnets always contain their natural quantity of fluid. Of courſe, their action on iron, and on each other, depends entirely on its unequal diſtribution.

The moſt important part of this theory is that which explains the induction of magnetiſm on iron and ſteel by juxtapoſition to a magnet; but before we can properly enter on that, we muſt notice ſome other particulars reſpecting the theoretical part of our ſubject.

80 Law of magnetic action.

A very material point in magnetiſm, as in electricity, is to aſcertain the law of action, according to which this power acts on the particles of iron and other matter; and accordingly this has long been an object of attention with philoſophers. The difficulty of aſcertaining this law is extremely great, as will readily appear by the following conſideration.

In the action of two magnets on each other, as A and B, there are four different actions to be conſidered that act at the ſame time, though with different degrees of force, and in different directions. Thus the north pole of A repels the north pole of B, and attracts its ſouth pole, while the ſouth pole of A exerts a repulſion on the ſouth pole of B, and an attraction on its north pole. Now the force, which we attempt to meaſure, is compounded of theſe four forces; and theſe we cannot meaſure ſeparately. The attraction obſerved is the exceſs of two attractions that are unequal above two unequal repulſions, and *v. v.* with reſpect to the obſerved repulſion. Further, if we reflect that it is poſſible for a mutual action to exiſt between every two particles of the different magnets, and that the intenſity of this action may vary, not only at different diſtances, but at the *ſame* diſtance, the difficulty will be greatly increaſed.

81 Experiments of Muſchenbroeck,

Numerous experiments have been made with a view of aſcertaining this law. Mr Cavallo has detailed many of thoſe made by Muſchenbroeck; but their reſults are ſo anomalous, that their inaccuracy is apparent. Indeed, the attempt to aſcertain this law by obſerving merely the attractions and repulſions, was very unphiloſophical.

82 Of Hawkſbee and Dr Brook Taylor,

The method employed by Mr Hawkſbee and Dr Brook Taylor, viz. obſerving how far the action of a magnet made a compaſs needle deviate from the meridian at different diſtances, was much more ſcientific, as this deviation is occaſioned by the difference of the two ſums of the ſame forces; and this may be made many times greater than the other, and muſt of courſe be much more ſenſible. The ſhape of the magnets employed by them was, however, very improper.

Theory. 83 Of Lambert.

Some experiments made by Mr Lambert of the academy of Berlin, were very judicious. He placed a magnetic needle at various diſtances from a magnet, but in the direction of its axis, and marked the declination from the magnetic line produced by the action of the magnet, and the obliquity of the magnet to the axis of the needle. Thus the action of the magnet and the natural polarity of the needle were placed in oppoſition and equilibrium; but the great difficulty was to diſcover the proportional change of theſe forces by their obliquity of action on this ſmall lever.

Mr Lambert obſerved, that when the obliquity of the magnet to the axis of the needle was $= 30°$, the needle was made to decline $15°$; and when the obliquity was $= 75°$, the needle declined $30°$. Let us call the obliquity o and the declination d, and let us put f for that function of the angle which is proportional to the action. Alſo let us call the natural polarity of the needle p, and the force of the magnet m. Then it is evident that $p \times f : 15 = m \times f : 30$; and $p : m = f, 30 : f, 15$; and for the ſame reaſon $p : m = f, 75 : f, 30$, and therefore $f, 15 : f, 30 = f, 30 : f, 75$. But ſine 15 : 30 = ſine 30 : ſ 75; hence Mr Lambert concluded, that the *ſine* was that function of the angle which was proportional to the action of magnetiſm on a lever. As this point, however, could not be determined by one experiment, he compared ſeveral other obliquities and declinations with the ſame diſtances, and with different diſtances of the magnet, and fully proved that he was right in his conjecture.

The reſult of Mr Lambert's experiments fully proves the fallacy of the theories of impulſion, which pretend to explain magnetic action by the impelling power of a ſtream of fluid, or by preſſure produced by the motion of ſuch a ſtream; as in ſuch a caſe the preſſure on the needle muſt have diminiſhed in the duplicate ratio of the ſine; or with the angle 90° the directive power muſt have been four times as much as with the angle of 30°, whereas it is ſhewn by obſervation to be only twice as much.

When Mr Lambert had aſcertained the effect of obliquity, he proceeded to examine that of diſtance; and he found, that if we put f for the force of the magnet, and ∂ for the diſtance of the neareſt pole of the magnet from the centre of the needle, and a for a conſtant quantity nearly equal to two thirds of the length of the needle, f will be proportional to $(\partial - a^2)$.

84 Dr Robiſon's inveſtigations.

Dr Robiſon endeavoured to inveſtigate this law in a very ſimple manner. He cauſed to be made ſome magnets conſiſting of two balls connected by a ſlender rod. By a particular mode of impregnation (which we ſuppoſe to be quenching them, after being red hot, between two magnets) he gave them a pretty good magnetiſm; and the force of each pole appeared to be nearly confined to the centre of the ball, which was his object in making them of ſuch a ſhape, as it reduced the examination of their attractive and directive power to a very eaſy computation. The reſult of his experiments was, that the force of each pole varied inverſely as the ſquares of the diſtances, or at leaſt the error ariſing from ſuch an hypotheſis was very ſmall, amounting only to one-fifteenth of the whole.

Dr Robiſon made a near approximation to the law of

Theory.

of action, by ſuppoſing that the function of the diſtance expreſſing that law, repreſented by the ordinates of a curve ſimilar to the hyperbola, referred to its aſſymptote as an axis, towards which its curve was of courſe always convex. On this ſuppoſition he explained the attractions and repulſions of magnets nearly in the following manner.

85 Picture of the magnetic forces.

Let there be two magnets, A and B (fig. 26.) placed ſo that their four poles, S, N, s, n, may be in a ſtraight line. Now, on the ſtraight line O q take O m, O p, O n, O q=N s, N n, S s, S n; and let MPNQ be a curve line, whoſe aſymptotic axis is the ſaid line O q. Draw the ordinates m M, p P, N n, q Q to the curve, and theſe will repreſent the intenſities of the forces exerted between the poles of the magnets. The diſtance between m, n, or between p and q = the length of the magnet A, and $m\,p$ or $n\,q$ = that of B, and M m, P p, N n and Q q, are pairs of ordinates that are equally diſtant. Now, it is eaſy to ſee from the figure, that in whatever ſituation the pairs of equidiſtant ordinates may be, M m+Q q will always exceed P p + N n, or the ſum of the attractions will be always greater than that of the repulſions.

Let the chords MQ, PN, MP, NQ be drawn. Biſect them in B, D, E, F, and join EF. Draw the ordinates E e, F f, and BD b (cutting EF in C). Draw P u parallel to the axis, cutting E e in ι. Draw alſo Q i parallel to the axis, cutting F f in φ. Alſo draw FHL parallel to the axis, and P $o\,t$ parallel to QN; and draw PL l, and P $e\,x$, cutting M m in l and x. Let each ordinate be repreſented by the letter at its interſection with the axis. Thus, the ordinates M m and Q q may be repreſented by m and q, &c. Becauſe MP is biſected in E, M t is double of E ι, M l is double EL, and M x double of E e. Again, P t being parallel to Q n, and P u to Q i, $t\,u$ equals N i.

86 If theſe ordinates are ſuppoſed to repreſent the mutual action of the magnetic poles, their tendency to or from each other, that is, their attractions or repulſions, may be expreſſed by $(m+q)—(n+p)$ which repreſent the exceſs of the ſum of the actions of the neareſt and moſt remote poles above the ſum of the action of the intermediate diſtant poles. This tendency may often be conveniently repreſented by $(n—p)—(n—q)$ or the exceſs of the difference of the actions exerted by the neareſt pole of A on the two poles of B, above the difference of the actions of the remote pole of A on the ſame poles of B. Now, 1. If we ſuppoſe the diſſimilar poles of A and B to front each other, $m+q$ will repreſent attractions, and $p+m$ repulſions; but $m+q$ is greater than $p+n$, therefore A and B will attract each other. Again $(m+q)—(p+n)$ equals M t, = 2 E o = 2 BD = 4 CD.

The above action will be increaſed by any one of four circumſtances, as, 1. By increaſing the ſtrength of either magnet. 2. By leſſening the diſtance between the two magnets. 3. Increaſing the length of A, the diſtance between it and B remaining the ſame. 4. By increaſing the length of B, the diſtance between it and A remaining the ſame.

2dly, Let us place the magnets, ſo that their ſimilar poles front each other. Here it is evident that the ordinates which in the former caſe repreſented attractions, will now repreſent repulſions, and that the repelling forces of the magnets are equal to the former attracting forces at the ſame diſtances. As magnets are ſeldom perfect, the repelling forces are, however, uſually weaker than the attracting.

87 Explanation of directive power.

To explain the directive power of magnets, Dr Robiſon ſuppoſed the magnet A not to be at liberty to approach B or recede from it, but to be ſupported at its centre B, ſo as to turn round it. Now, its ſouth pole s being more attracted by N than it is repelled by S, B is on the whole attracted by A, and by this attraction would vibrate like a pendulum ſupported at the centre B. Again, the north pole n being repelled by N more than it is attracted by S, will be on the whole repelled, and B n would alſo vibrate round B. Thus B would be kept in the poſition s B n. This will be more evident if we ſuppoſe the magnet B arranged at right angles to the line AB, as in the dotted repreſentation s' B n'; for now s' and n' are urged in oppoſite conſpiring directions with equal forces, which, if the magnet be very ſmall, will act nearly at right angles to $n'\,s'$. If the poſition were oblique, the forces would be ſomewhat unequal; and allowances muſt be made for the obliquity of the action, that we may know the preciſe rotative momentum. This modification of the action of A on B, we call the directive power of A; and the modification of B, by which it tends to or from A, we call the polarity of B.

Now, the directive power of A and the polarity of B may be increaſed, 1. By increaſing the ſtrength of either A or B, or both; 2. By diminiſhing the diſtance between A and B; 3. By increaſing the length of A; and, 4. By diminiſhing the length of B the diſtance between them remaining the ſame.

We may remark, that the directive power of A is always greater than its attractive power, by a certain meaſure which we may repreſent by the formula $2\,(p—q)$ which is thus derived. The difference between them may be expreſſed by $t\,l = 2\,o$ L; but $\iota\,e$= P p = p, and ι L = P p — F f = P p — Q q — F φ = P p — Q q — $o\,\iota$; therefore o L = P p — Q q, and $t\,l$ = 2 (P p — Q q) = $2\,(p—q)$.

88 Curious phenomenon.

This picture of the forces, attentively examined, will ſuggeſt to the reader many intereſting and inſtructive particulars. Dr Robiſon uſed to relate a curious and inſtructive phenomenon that he was long puzzled to explain, reſpecting the mutual action of large magnets. Amuſing himſelf with ſome experiments on magnetiſm, with two large ſtrong magnets, as AB, fig. 27. which were placed at about the diſtance of three inches with their oppoſite poles fronting each other, he had placed a ſmall needle balanced on a point between them as at D, which arranged itſelf in the ſame line with the magnets; but happening to ſet it off to a conſiderable diſtance on the table, as at F, he was ſurpriſed to ſee it inſtantly turn round on the point, and arrange itſelf in an oppoſite direction. When brought back to D, it reaſſumed its former poſition, but when he carried it out gradually along the line DF, perpendicular to N s, he found it grow ſenſibly more feeble, vibrating more ſlowly; and when arrived at a certain point E, it ſhewed no polarity towards either A or B, but retained any poſition given it: but when carried farther out, it again acquired polarity to the magnets, though in a contrary direction, arranging itſelf parallel to N S, with its north pole next to N, and ſouth pole next to S. Being interrupted

Theory.

interrupted in the profecution of this experiment, but having marked the line DF on the table, he afterwards replaced the magnets and needle, placing the latter at E, where he expected it to be neutral; but it now turned its north pole towards B, and did not become neutral till carried further out. When ftanding there, fomething happened to move the magnets A and B, which inftantly rufhed together, and at the fame inftant the needle turned itfelf brifkly, and arranged itfelf as before at F. In fhort, by gradually withdrawing the magnets from each other, he found that the needle firft became weaker, then neutral, and then turned into the oppofite pofition.

Dr Robifon explained this curious phenomenon by what he calls primary and fecondary magnetic curves, fuch as NHM, NEL, and SGK, SEI; but our limits do not permit us to enter here on the inveftigation of thefe curves.

89 Law of action probably *inverfely as the fquares of the diftances.*

From all Dr Robifon's experiments and calculations, he appears to have been fully convinced, that the true law of magnetic action is in the *inverfe duplicate ratio of the diftances*, and his opinion is ftill farther ftrengthened by the ingenious experiments of M. Coulomb related in the *Memoirs of the Academy of Sciences at Paris* for 1786 and 1787, or the *Jour. de Phy.* vol. xliii.

We are now prepared to examine the induction of magnetifm in iron or fteel by juxtapofition to a magnet, the general facts of which are mentioned and illuftrated in N° 44.

It was remarked in N° 46, that the induction of magnetifm in the iron by being near a magnet was not produced by a transference of fomething from the magnet to the iron. It follows that there muft be fome inherent property in iron, which is only excited, as it were, or roufed into action, by the proximity of the magnet.

It has been remarked, that the magnetifm of iron is momentary, but this muft be underftood only of the fineft and pureft iron, as when this metal is in the ftate of ore, or has undergone any change, as by expofure to the air, or by cementation, its magnetifm becomes permanent, in proportion to the hardnefs of the metal.

90 Induced magnetifm gradual.

It is of great importance to obferve that the acquifition of induced magnetifm is gradual and progreffive, and that this gradation is more perceptible according as the iron is in a harder ftate. In foft iron the induction appears to be inftantaneous throughout, unlefs the bar be exceedingly long; but when a magnet is brought near a bar of tempered fteel, the near end acquires a contrary polarity long before the remote end appears affected, and it is a long time before the remote end acquires the fame polarity with the proximate end of the magnet.

91 Iron attracted only becaufe it becomes magnetical.

From what has been faid we may infer, that a piece of iron brought near a magnet, is attracted only becaufe it becomes magnetical by induction, and that the attraction of a loadftone for iron, or the tendency of iron to the loadftone, is the confequence of the proper difpofition of the magnetifm induced in the iron. It has already appeared, that this phenomenon arifes from the excefs of two attractions above two repulfions, and this is farther proved by the following confiderations: 1. That the magnetifm of the two poles is evidently of an oppofite nature, the one attracting what the other repels, and *vice verfa*. If a piece of iron is attracted by one, it ought therefore to be repelled by the other; but each pole, by inducing on the near end of the iron a magnetifm oppofite to its own, and on the remote end a fimilar magnetifm, and its action diminifhing as the diftance increafes, the attraction muft always be in excefs, and the iron muft on the whole be attracted. 2. When we have two magnets placed in a parallel pofition, with their oppofite poles together, if a piece of common iron be brought near their extremities, the different poles counteracting each other, the piece of iron will not be fupported by the two magnets together, unlefs there is an inequality of action; but it is evident that either of them alone would be capable of fupporting the iron. 3. In all the cafes where the induction of magnetifm is flow, the attraction is proportionally weak, and the attraction increafes exactly according to the increafe of the progreffive induction. 4. An ore of iron that is not capable of acquiring magnetifm, is not attracted by the magnet, and on the other hand it is an univerfal fact, that no fubftance which is not attracted by the magnet, can be rendered magnetical.

The induction of magnetifm by juxtapofition affords a complete explanation of the curious arrangement of iron filings round a magnet. Let us fuppofe a great many fmall oblong pieces of iron to be lying near each other on the furface of mercury, and that a ftrong magnet be brought into the midft of them. They are all immediately rendered magnetical by induction; any one that is neareft the north pole of the magnet acquiring two poles, one a north and the other a fouth pole, turns the fouth pole towards the north pole of the magnet, and the north pole away from it; a fimilar effect is produced on another piece or filing that lies near the firft, and fo on of the reft. All thofe that lie near each other muft mutually attract, as the magnetifm of each is fo difpofed that both ends of it are in a ftate of attraction towards one or other of its neighbours. They will therefore arrange themfelves by coalefcence in a particular manner; if they are near enough, they will unite by their extremities, and if they are at fome diftance they will point towards each other, forming curved lines. 92 Arrangement of iron filings explained.

It is found that the magnetifm of magnets, whether natural or artificial, is continually tending to decay. Now as we find that this magnetifm may be induced merely by the approach of a magnet, and as we know that in producing magnetifm, magnets may oppofe each other, it is reafonable to conclude, that when a flight though permanent magnetifm has been acquired by a piece of iron by its vicinity to a magnet, it may be deftroyed, and the contrary magnetifm induced, by applying a magnet in the oppofite direction. Accordingly it is a well-known fact, that the poles of magnets made of foft fteel can be reverfed at pleafure. 93 Magnetifm can be reverfed.

This explains why magnetic repulfion is always weaker than attraction at the fame diftance, as magnets, when placed with their fimilar poles fronting each other, in order to try their repulfion, are thereby weakened; whereas, on the contrary, magnets applied with their oppofite poles, fo as to attract each other, are thereby improved, and their attractive powers are made to appear greater than they really are.

It has been obferved that a magnet is not weakened by inducing magnetifm on iron. In fact, it is rather improved

Theory.

improved by such induction, and this will increase he effect; for as the magnet is improved, the induced magnetism of the iron will be thereby increased, and thus the magnet will be thus farther improved.

After what has been said, we need not enter further into an explanation of the phenomena, or of the processes employed in making artificial magnets. They are all referable to this one fact of the induction of magnetism by juxtaposition, and explanations will readily suggest themselves to readers who carefully consider the preceding facts, and compare them with Dr Gilbert's theory of terrestrial magnetism.

94 Objection to terrestrial magnetism answered.

It is now time for us to return to Dr Gilbert's hypothesis, and consider an objection that has been strongly urged against it.

There is observed no tendency in the magnetic needle towards the great terrestrial magnet, that is, though, when made to float on water, it speedily acquires directive power, it does not in these latitudes approach the north side of the vessel, nor does an iron bar appear heavier when its south pole is uppermost, as ought to be the case on account of the attraction of the great magnet. Dr Gilbert saw this objection, and it appears to have given him some concern. He attempted to get rid of it by observing that the directive power of a magnet is greater than its attractive force; a fact in support of which he brings many experiments. A much more satisfactory answer may be derived from what has been stated respecting the actions of the four poles. We thence find, that the polarity of the needle depends on the difference of the *sums* of the actions of each pole of the magnet on both poles of the needle; whereas its tendency towards the magnet arising from the attraction between them, depends on the difference of the *differences* of the same actions. Hence the former may be very great while the latter is very small. We find that small iron filings are much less forcibly attracted by magnets than coarse ones, and, if we consider that the largest magnets which we employ do not bear so great a proportion to the earth, as the finest iron filings to an ordinary magnet, we shall not wonder that the attractive power of the earth is not very sensible.

As this objection is one of the strongest that can be brought against the theory, and as we may consider this as done away, we may now receive the theory as just so far as it goes. We must remark, that though we call that pole of a magnet which inclines towards the earth in the northern latitudes, a *north* pole, it is properly speaking a *south* pole; for as we must call that pole of the *great* magnet the north pole which is in the north, and as this pole produces the contrary polarity in the proximate end of a needle, that end must be possessed of *south* polarity. We shall return to this subject in the article VARIATION.

Some valuable observations on terrestrial magnetism have lately been made in France by M. M. Humboldt and Biot, and as they would suffer materially by abridgement, we shall present our readers with the greatest part of the memoir nearly as translated in the Philosophical Magazine, vol. xxii.

95 Observations of Humboldt and Biot.

After explaining the object of the memoir, and giving an account of the share that he had in conducting the observations, M. Biot proceeds as follows.

It is necessary to consider the action of terrestrial magnetism under different points of view, corresponding to the different classes of the phenomena which it produces.

96 Magnetism acts on the whole surface of the globe.

If we consider it first in general, we find that it acts on the whole surface of the globe, and that it extends beyond it. This fact, which was doubted, has been lately proved by M. Guy-Lussac, during his two aërostatic voyages. And if these observations, made with all the care possible, have not shewn the least sensible diminution in the intensity of the magnetic force, at the greatest height to which man can attain, we have a right to conclude that this force extends to an indefinite distance from the earth, where it decreases, perhaps, in a very rapid manner, but which at present is unknown to us.

If we now consider magnetism at the surface even of the earth, we shall find three grand classes of phenomena which it is necessary to study separately, in order to have a complete knowledge of its mode of action. These phenomena are, the declination of the magnetic needle, its inclination, and the intensity of the magnetic force, considered either comparatively in different places or in themselves, paying attention to the variations which they experience. It is thus that, after having discovered the action of gravity as a central force, its variation, resulting from the figure of the earth, was afterwards ascertained in different latitudes.

The declination of the magnetic needle appears to be that phenomenon which hitherto has more particularly fixed the attention of philosophers, on account, no doubt, of the assistance which they hoped to derive from it in determining the longitude; but when it was known that the declination changes in the same place, in the course of time, when its diurnal variations were remarked, and its irregular traversing occasioned by different meteors, in a word, the difficulty of observing it at sea, within one degree nearly, it was necessary to abandon that hope, to consider the cause of these phenomena as much more complex and abstruse than had been at first imagined.

97 Magnetic power increases from the equator to the poles.

In regard to the intensity of the magnetic power in different parts of the earth, it has never yet been measured in a comparative manner. The observations of M. Humboldt on this subject have discovered a very remarkable phenomenon; it is the variation of the intensity in different latitudes, and its increase proceeding from the equator to the poles.

The compass, indeed, which at the departure of M. Humboldt gave at Paris 245 oscillations in 10 minutes, gave no more in Peru than 211, and it constantly varied in the same direction; that is to say, the number of the oscillations always decreased in approaching the equator, and always increased in advancing towards the north.

These differences cannot be ascribed to a diminution of the force in the magnetism of the compass, nor can we suppose that it is weakened by the effect of time and of heat; for after three years residence in the warmest countries of the earth, the same compass gave again in Mexico oscillations as rapid as at Paris.

There is no reason to doubt the justness of M. Humboldt's observations, for he often observed the oscillations in the vertical plane perpendicular to that meridian; and by decomposing the magnetic force in the

Theory.

the latter plane, and comparing it with its total action, which is exercised in the former, we may from these data calculate its direction, and consequently the direction of the needle (c). This inclination, thus calculated, is found always conformable to that which M. Humboldt observed directly. When he made his experiments, however, he could not foresee that they would be subjected to this proof by which M. Laplace verified them.

As the justness of these observations cannot be contested, we must allow also the truth of the result which they indicate, and which is the increase of the magnetic force proceeding from the equator to the poles.

98 Humboldt's determination of the magnetic equator.

To follow these results with more facility, it will be proper to set out from a fixed term; and it appears natural to make choice for that purpose of the points where the inclination of the magnetic needle is null, because they seem to indicate the places where the opposite action of the two terrestrial hemispheres is equal. The series of these points forms on the surface of the earth a curved line, which differs very sensibly from the terrestrial equator, deviating from it to the south of the Atlantic ocean, and to the north in the south sea. M. Humboldt found this equator in Peru about 7° 1′ S. Lat. which for that part of the earth places it nearly in the spot where Wilke and Lemounier had fixed it.

The places situated to the north of that point may be divided into four zones, the three first of which, being nearer the equator, are about 4° of latitude, while the latter, more extensive and more variable, is 14°. So that the system of these zones extends in America from the magnetic equator to 23° of north latitude, and comprehends in longitude an interval of about 50°.

The first zone extends from 7° 1′ of south latitude to 2° 54′. The mean number of the oscillations of the needle in the magnetic meridian in 10′ of time is there 211,9: no observation gives less than 211, or more than 214. From M. Humboldt's observations one might form a similar zone on the south side of the magnetic equator, which would give the same results.

The second zone extends from 2° 13′ of south latitude to 3° 15′ of north latitude. The mean term of the oscillations is there 217.9: they are never below 220, nor above 226.

The fourth zone, broader than the other two, extends from 9° 15′ to 23° 8′ of north latitude. Its mean term is 237: it never presents any observation below 229, nor above 240.

We are unacquainted, in regard to this part of the earth with the intensity of the magnetic force beyond the latitude of 23° north; and on the other hand, in Europe, where we have observations made in high latitudes, we have none in the neighbourhood of the equator; but we will not venture to compare these two classes of observations, which may belong to different systems of forces, as will be mentioned hereafter.

However, the only comparison of results, collected in America by M. Humboldt, appears to us to establish with certainty the increase of the magnetic force from the equator to the poles; and, without wishing to connect them too closely with the experiments made in Europe, we must remark, that the latter accord so far also with the preceding as to indicate the phenomenon.

If we have thus divided the observations into zones parallel to the equator, it is in order that we may more easily shew the truth of the fact which results from them, and in particular to render the demonstration independent of those small anomalies which are inevitably mixed with these results.

Though these anomalies are very trifling, they are however, so sensible, and so frequently occur, that they cannot be ascribed entirely to errors in the observations. It appears more natural to ascribe them to the influence of local circumstances, and the particular attractions exercised by collections of ferruginous matters, chains of mountains, or by the large masses of the continents.

One of them, indeed, having carried to the Alps the magnetic needle employed in an aërial excursion, he found that its tendency to return to the magnetic meridian was constantly stronger in these mountains than it was at Paris before his departure, and than it has been found since his return. This needle, which made at Paris 83.9° in 10′ of time, has varied in the following manner in the different places to which it was carried.

 Places

(c) Let HOC (fig. 28.) be the plane of the magnetic meridian passing through the vertical OC; let OL be the direction of the needle situated in that plane, and OH a horizontal. The angle LOH will be the inclination of the needle, which we shall denote by I. If F represent the total magnetic force which acts in the direction OL, the part of this force which acts according to OC, will be F sine of I: but the magnetic forces which determine the oscillations of the needle in any plane, are to each other as the squares of the oscillations made in the same time. If we denote them by M, the number of oscillations made in 10′ of time in the magnetic meridian, and by P, the number of oscillations made also in 10′, in the perpendicular plane, we shall have the following proportion:

$$\frac{F \text{ sin. } I}{F} = \frac{P^2}{M^2}$$

from whence we deduce

$$\text{Sin. } I = \frac{P^2}{M^2}.$$

The inclination then may be calculated by this formula' when we have oscillations made in the same planes.

In like manner, by making a needle oscillate successively in several vertical planes, we might determine the direction of the magnetic meridian.

Theory.

Places of Obſervation.	*Number of Oſcillations in 10′ of Time.*
Paris, before his departure,	83.9
Turin,	87.2
On Mount Genêvre,	88.2
Grenoble,	87.4
Lyons,	87.3
Geneva,	86.5
Dijon,	84.5
Paris, on his return,	83.9

99 Terreſtrial magnetiſm modified by local circumſtances.

These experiments were made with the greateſt care, conjointly with excellent obſervers, and always employing the ſame watch verified by ſmall pendulums, and taking the mean terms between ſeveral ſerieſes of obſervations, which always differed very little from each other. It appears thence to reſult, that the action of the Alps has a ſenſible influence on the intenſity of the magnetic force. M. Humboldt obſerved analogous effects at the bottom of the Pyrenees; for example, at Perpignan. It is not improbable that they aroſe from the maſs of theſe mountains, or the ferruginous matters contained in them; but whatever may be the cauſe, it is ſeen by theſe examples that the general action of terreſtrial magnetiſm is ſenſibly modified by local circumſtances, the differences of which may be perceived in places very little diſtant from each other. This truth will be further confirmed by the following obſervations.

It is to cauſes of this kind, no doubt, that we muſt aſcribe the diminution of the magnetic forces obſerved in ſome mountains; a diminution which, on the firſt view, might appear contrary to the reſults obtained during various aërial voyages. This conjecture is ſupported by ſeveral obſervations of M. Humboldt. By making his needle to oſcillate on the mountain of Guadaloupe, which riſes 338 toiſes above Santa-Fé, he found it in 10′ of time give two oſcillations leſs than in the plain. At Silla, near Caracas, at the height of 1316 toiſes above the coaſt, the diminution went ſo far as five oſcillations; and on the other hand, on the volcano of Antiſana, at the height of 2467 toiſes, the number of oſcillations in 10 minutes was 230; though at Quito it was only 218, which indicates an increaſe of intenſity. A ſimilar effect was obſerved on the ſummit of Mount Genevre, at the height of 800 or 900 toiſes, as may be ſeen from the numbers already given; and on this mountain M. Biot found the greateſt intenſity of the magnetic force. He ſaw on the hill of La Superga, in the neighbourhood of Turin, an example of theſe variations equally ſtriking. Obſerving, with Vaſſali, on this hill, at the elevation of 300 toiſes, they found 87 oſcillations in 10 minutes of time. On the ſide of the hill they had 88.8 oſcillations, and at the bottom, on the bank of the Po, they obtained 87.3. Though theſe reſults approach very near to each other, their difference is, however, ſenſible, and fully ſhews that their ſmall variations muſt be conſidered as ſlight anomalies produced by local circumſtances.

This examination leads us to conſider the intenſity of magnetiſm on the different points of the ſurface of the globe, as ſubject to two ſorts of differences. One kind are general; they depend merely on the ſituation of the places in regard to the magnetic equator, and belong to a general phenomenon, which is the increaſe of the intenſity of the magnetic forces in proportion as we remove from the equator; the other kind of variations, which are much ſmaller and altogether irregular, ſeem to depend entirely on local circumſtances, and modify either more or leſs the general reſults.

If we conſider terreſtrial magnetiſm as the effect of an attractive force inherent in all the material particles of the globe, or only in ſome of theſe particles, which we are far from determining, the general law will be, the total reſult of the ſyſtem of attraction of all the particles, and the ſmall anomalies will be produced by the particular attractions of the partial ſyſtems of the magnetic moleculæ diffuſed irregularly around each point; attractions rendered more ſenſible by the diminution of the diſtance.

It now remains to conſider the inclination of the magnetic needle in regard to the horizontal plane. It has been long known that this inclination is not every where the ſame; in the northern hemiſphere the needle inclines towards the north; in the ſouthern towards the ſouth; the places where it becomes horizontal form the magnetic equator; and thoſe where the inclination is equal, but not null, form on each ſide of that equator curved lines, to which the name of magnetic parallels has been given, from their analogy to the terreſtrial parallels. One may ſee in ſeveral works, and particularly in that of Lemounier, entitled *Lois du Magnetiſme*, the figure of theſe parallels, and their diſpoſition on the face of the earth.

100 Inclination of the needle increaſes as we proceed from the magnetic equator.

It evidently reſults from this diſpoſition, that the inclination is in proportion as we recede from the magnetic equator; but the law which it follows in its increaſe, has not yet, as far as appears to us, been given. To aſcertain this law, however, would be of great utility; for the inclination ſeems to be the moſt conſtant of all the magnetic phenomena, and it exhibits much fewer anomalies than the intenſity. Beſides, if any rule well confirmed could be diſcovered on this ſubject, it might be employed with advantage at ſea to determine the latitude, when the weather does not admit an obſervation of the ſun; which is the caſe in various places during the greater part of the year. We have ſome reaſon to expect this application, when we ſee the delicacy of that indication in the obſervations of M. Humboldt, where we find 35′ 6″ of difference between two towns ſo near each other as Niſmes and Montpellier. Theſe motives have induced us to ſtudy with great intereſt the ſeries of obſervations made by M. Humboldt in regard to the inclination; and it appears to us that they may be repreſented very exactly by a mathematical hypotheſis, to which we are far from attaching any reality in itſelf, but which we offer merely as a commodious and ſure mode of connecting the reſults.

To diſcover this law, we muſt firſt exactly determine the poſition of the magnetic equator, which is as an intermediate line between the northern and the ſouthern inclinations. For this purpoſe we have the advantage of being able to compare two direct obſervations, one of La Perouſe, and the other of M. Humboldt. The former found the magnetic equator on the coaſts of Braſil at 10° 57′ of ſouth latitude, and 25° 25′ of weſt longitude, counted from the meridian of Paris. The latter found the ſame equator in Peru at 7° 1′ of ſouth latitude, and 80° 41′ of weſt longitude, alſo reckoning from the ſame meridian. Theſe data are ſufficient

Theory.

cient to calculate the position of the magnetic equator, supposing it to be a great circle of the terrestrial sphere; an hypothesis which appears to be conformable to observations. The inclination of this plane to the terrestrial equator is thus found to be equal to $10^{\circ}\ 58'\ 56''$, and its occidental node on that equator is at $120^{\circ}\ 2'\ 5''$ west from Paris, which places it a little beyond the continent of America, near the Gallipagos, in the South sea; the other node is at $59^{\circ}\ 57'\ 55''$ to the east of Paris, which places it in the Indian seas. (D)

"We do not give this determination as rigorously exact; some corrections might no doubt be made to it, had we a greater number of observations equally precise; but we are of opinion that these corrections would be very small, and it will be seen afterwards that, independently of the confidence which the two observations we have employed deserve, we have other reasons for entertaining this opinion. (E)

"It is very remarkable that this determination of the magnetic equator agrees almost perfectly with that given long ago by Wilke and Lemounier. The latter in particular, who for want of direct observations had discussed a great number of corresponding observations, indicates the magnetic equator in Peru towards $7^{\circ}\ 20'$ of south latitude, and M. Humboldt found it in the same place at $7^{\circ}\ 1'$; besides, Lemounier's chart, as well as that of M. Wilke, indicates for the inclination of the magnetic meridian about 11°, and they place the node about 140° of west longitude, reckoned from the meridian of Paris.

"Can it be by chance, then, that these elements, found more than 40 years ago, should accord so well with ours founded on recent observations? or does the inclination of the magnetic equator experience only very small variations, while all the other symptoms of terrestrial magnetism change so rapidly? We should not be far from admitting the latter opinion, when we consider that the inclination of the magnetic needle has changed at Paris 3° in 60 years since it has been observed; and that at London, according to the observations of Mr Graham, it has not changed 2° in 200 years, while the declination has varied more than 20° in the same interval, and has passed from east to west: but on the other hand the observation of the inclination is so difficult to be made with exactness, and it is so short a time since the art of measuring it with precision was known, that it is perhaps more prudent to abstain from any premature opinion on phenomena, the cause of which is totally unknown to us."

To employ the other observations of M. Humboldt in regard to the inclination, the terrestrial latitudes and longitudes reckoned from the magnetic equator were first reduced. The latter, being reckoned from the node of that equator in the South sea, M. Biot first perceived by these calculations that the position of that plane determined by preceding researches was pretty exact; for some of the places, such as Santa-Fé and Javita, where M. Humboldt observed inclinations almost equal, were found nearly on the magnetic parallel, though distant from each other more than 60° of longitude.

When these reductions were made, M. Biot endeavoured to represent the signs of the inclinations observed, and to leave as little to chance as possible. He first tried a mathematical hypothesis conformable enough to the idea which has hitherto been entertained in regard to terrestrial magnetism.

He supposed in the axis of the magnetic equator, and at an equal distance from the centre of the earth, two centres of attractive forces, the one austral and the other boreal, in such a manner as to represent the two opposite magnetic poles of the earth. He then calculated the effect which ought to result from the action of

(D) To calculate this position, let NEE′ (fig. 29.) be the terrestrial equator; NHL the magnetic equator, supposed also to be a great circle, and HL the two points of that equator, observed by Messrs Humboldt and La Perouse. The latitudes HE, LE′, and the arc EE′, which is the difference of longitude of these two points, is known; consequently, if we suppose $HE=b$, $LE'=b'$, $EE'=v$, $EN=x$, and the angle $ENH=y$, we shall have two spherical triangles NEH, NE′L, which will give the two following equations:

$$\text{sin. } x=\frac{\text{tang. } b \text{ cot. } y}{R}\ \text{sin. } (x+v)=\frac{\text{tang. } b' \text{ cot. } y}{R};$$

from which we deduce

$$\text{sin. } \frac{(x+v)}{\text{sin. } x.}=\frac{\text{tang. } b'}{\text{tang. } b},$$

and developing

$$\text{cot. } x=\frac{\text{tang. } b \text{ sin. } v}{\text{tang. } b'}-\frac{\text{cos. } v}{\text{sin. } v}.$$

Let us now take an auxiliary angle φ; so that we may have

$$\text{tang. } \varphi=\frac{\text{tang. } b \text{ sin. } v}{\text{tang. } b'},$$ and we shall have

$$\text{tang. } x=\frac{\text{sin. } v \text{ sin. } \varphi}{\text{sin. } (v-\varphi)}.$$

By these equations we may find x, and then y, by any of the first two.

(E) La Perouse, after having doubled Cape Horn, fell in a second time with the magnetic equator in $18'$ north latitude, and $119^{\circ}\ 7'$ of longitude west from Paris. He was therefore very near the node of the magnetic equator, such as we have deduced it from observations. This fact establishes in a positive manner two important consequences: First, that the preceding determinations require only very slight corrections; and the second, that the magnetic equator is really a great circle of the earth, if not exactly, at least very nearly.

Theory.

of these centres in any point of the surface of the earth, making their attractive force reciprocally vary as the square of the distance; and in this manner he obtained the direction of the result of their forces, which ought to be that also of the magnetic needle in that latitude.

He supposes that the point B (fig. 30.) is the north magnetic pole of the earth, and that the point A is the south magnetic pole; he supposes also that there is in the point M, at the surface of the earth, a molecula of the austral fluid which is attracted by B and repelled by A in the inverse ratio of the square of the distance; and he requires what will be the direction of the power resulting from these two forces acting on that molecula. It is evident that this direction will be that also which would be assumed in the point M by the needle of a compass freely suspended; for, in consequence of the smallness of the needle in comparison of the radius of the earth, the lines drawn from its points to one centre, B or A, may be considered as parallel, especially if the points A and B are near the centre of the earth, which is the case with nature, as may be seen.

He first supposes that the earth has a spherical figure, and that the two poles A and B are equal in force, and he then examines how far the latter supposition agrees with the results observed.

Let AM then $=D'$, BM $=D$, CP $=x$, PM $=y$, the angle MCP $=u$, CA $=$ CB $=a$. He then makes $a=Kr$; r being $=$ the radius of the earth, and K a constant but indeterminate quantity.

Let X, Y, also be the forces which attract M in the direction of the axes of the co-ordinates, and β the angle which the resulting force makes with the axis ABC.

Theory.

He then gives the following equations, in which F is the magnetic force, at a distance equal to unity.

$$x=\frac{F}{D^2}\text{cos. MBD}-\frac{F}{D'^2}\text{cos. MAD};$$

$$D'^2=y^2+(x+a)^2=r^2+2\,\text{axis}+a^2,$$

$$Y=\frac{F}{D^2}\text{sin. MBD}-\frac{F}{D'^2}\text{sin. MAD};$$

$D^2=y^2+(x-a)^2=r^2-2\,\text{axis}+a^2$, or, by putting for the cosines their values:

$$X=\frac{F(x-a)}{D^3}-\frac{F(x+a)}{D'^3}$$

$$Y=\frac{Fy}{D^3}-\frac{Fy}{D'^3},$$

and as we have

$$\text{tang. }\beta=\frac{Y}{X},$$

we shall have also

$$\text{tang. }\beta=\frac{\frac{Y}{D^3}-\frac{Y}{D'^3}}{\frac{x-a}{D^3}-\frac{x+a}{D'^3}}=\frac{y(D'^3-D^3)}{(D'^3-D^3)-a(D'^3+D^3)};$$

and by putting for x, y and a, their values, cos. u; r sin. u, Kr;

$$\text{tang. }\beta=\frac{\text{sin. }u}{\text{cos. }u-K\left(\frac{D'^3+D^3}{D'^3-D^3}\right)},$$

$$D'^2=r^2(1+2K\text{ cos. }u+K^2);$$

$$D^2=r^2(1-2K\text{ cos. }u+K^2);$$

which gives the system of the two equations,

$$\text{tang. }\beta=\frac{\text{sin. }u}{\text{cos. }u-K\left(\frac{D'^3+D^3}{D'^3-D^3}\right)},$$

$$K\left(\frac{D'^3+D^3}{D'^3-D^3}\right)=\frac{(1+2K\text{ cos. }u+K^2)^{\frac{3}{2}}+(1-2K\text{ cos. }u+K^2)^{\frac{3}{2}}}{(1+2K\text{ cos. }u+K^2)^{\frac{3}{2}}-(1-2K\text{ cos. }u+K)^{\frac{3}{2}}}K.$$

These equations determine the direction of the magnetic needle in regard to each point M, the distance of which from the magnetic equator is known; but it is seen that this direction depends on the quantity K, which represents the distance of the magnetic centres from the centre of the earth; this distance being expressed in parts of the terrestrial radius, we must therefore first determine this quantity from observations.

To do it in the manner of approximation, and thus acquire a first idea of the value of K, M. Biot chose an observation made by M. Humboldt at Carichana in 6° 34′ 5″ of north latitude counted from the terrestrial equator, and 70° 18′ west longitude reckoned from the meridian of Paris, which gives 14° 52′ 25″ of longitude counted from the magnetic equator, and 48° 51′ 53″ of west longitude, proceeding from the node formed by that equator with the equator of the earth. The inclination of the magnetic needle was observed in that place by M. Humboldt in the month of Messidor, year 8, and found to be equal to 33,78° of the centigrade division. A comparison of this result with the other observations of M. Humboldt, shews that it may indeed be considered as agreeing to that latitude.

To make use of it, M. Biot successively gave to K different values in the formula; he calculated the inclinations resulting from that latitude; and comparing these results with that which M. Humboldt really observed, the progress of the errors naturally led him to the most proper supposition. The following is a table of these trials.

Values of K.	Inclinations of the Needle.	Errors.
K=1	7.73°	26.04
K=0.6	18.80	14.97
K=0.5	22.04	11.73
K=0.2	29.38	4.39
K=0.1	30.64	3.13
K=0.01	31.04	2.73
K=0.001	31.07	2.7

The first value of K would place the centre of the magnetic forces at the surface of the earth and the poles of the magnetic equator. It is seen that this supposition cannot be admitted, because it would give an increase of inclination much less rapid than that indicated by observations. The case is the same with the following

Theory.

following results, which place the centres of action on the terrestrial radius at different distances from the centre of the earth; but it is seen also in general, that they approach more and more to the truth in proportion as this distance becomes less; which evidently shews that the two centres of action of the magnetic forces are situated near the centre of the earth. All the other observations of M. Humboldt would also lead to the same consequence.

The most proper supposition would be to make K null, or so small that it would be needless to pay attention to it; which amounts to the same thing as to consider the two centres of action placed, as we may say, in the same molecula. The result, indeed, obtained in this manner is the most exact of all; it is $=31.0843°$; this value is still a little less than that which M. Humboldt observed, and the difference is $=2.69$; but it must be considered also that the formula from which we derive these values supposes the position of the magnetic equator is perfectly determined; but it may not be so with the utmost exactness, according to the two only observations of La Perouse and Humboldt, which we have employed. It is therefore by studying the progress of the formula, and comparing it with the observations, that we are able to appreciate it justly; after which we may think of remedying the small errors with which it may be accompanied.

To obtain the result here mentioned, and which is, as it were, the limit of all those which may be obtained by giving to K different values, it is to be remarked that the quantity

$$K\left(\frac{D'^3+D^3}{D'^3-D^3}\right),$$

or,

$$K\frac{(1+2K\text{ cos. }u+K^2)^{\frac{3}{2}}+(1-2K\text{ cos. }u+K^2)^{\frac{3}{2}}}{(1+2K\text{ cos. }u+K^2)^{\frac{3}{2}}-(1-2K\text{ cos. }u+K^2)^{\frac{3}{2}}}$$

becomes $\frac{0}{0}$ when K is null; but by applying to it the methods of known quantities, it will be found that its value in this supposition is really determinate and $=\frac{1}{3\text{ cos. }u}$. By substituting this in the formula we shall have

$$\text{tang. }\beta=\frac{\text{sin. }u}{\text{cos. }u-\frac{1}{3\text{ cos. }u}}$$

an equation which may be reduced to this form:

$$\text{tang. }\beta=\frac{\text{sin. }u}{\text{cos. }2u+\frac{1}{3}};$$

which will easily give the value of β; and when this value is known, we shall have the inclination I, by the following formula:

$$I=100+u-\beta,$$

which will serve throughout the whole extent of the two hemispheres.

From the progress thus traced out, it is seen that the preceding formula is not merely an empyric construction of observations; on the contrary, it is totally independent, and only supposes the inclination of the magnetic needle to be produced by a magnet infinitely small, placed in the centre of the terrestrial surface; but by calculating from this formula the inclination for the different latitudes, M. Biot found precisely the same numbers as M. Humboldt observed either in Europe or America; and it is not his observations only that are represented in this manner; but those which have been made in Russia, and at Kola in Lapland, during the last transit of Venus, are also comprehended under the same law.

Theory.

It is seen that the results of the formula deviate very little from the observations; but these differences may be rendered still smaller. By examining, indeed, the progress of the errors, it is seen that the numbers given by calculation are a little too small in America for the low latitudes, and a little too great for the high latitudes, which shews that the whole may be allowed, with some slight modifications, either by changing, however little, the node and inclination of the magnetic equator, which two observations cannot determine with the utmost exactness, or by displacing ever so little our small magnet, leaving, however, its centre in the plane of the magnetic equator, and placing it in such a manner that it shall be a little nearer America than Europe. It is by these observations themselves, when we shall have a greater number, that we must be guided in these small corrections.

In a word, it must not be expected that we can represent in a rigorous manner, by a mathematical law, all the inclinations observed; for the phenomenon of the inclination, though more regular than the other magnetic effects, is not free from some anomalies; this may be easily seen on constructing the curve given by the observations themselves. Thus, for example, the inclination observed at Popayan is 0° 10′ greater than at St Carlos del Rio Negro, though the magnetic latitude of the latter is 3° 7′ greater. The case is the same with observations made at Javita and Santa Fé. Other anomalies are discovered in the comparative progress of the observations and formula. This is the case in regard to Carichana, St Thomas de la Guyane, and Carthagena. The increase of the inclination from the first to the second of these points is by no means in harmony with the increase from the second to the third; and if we compare together the intensities observed in these different places, the anomalies they exhibit announce in some measure those which the inclination ought to experience.

The cause of these anomalies becomes evident from what has been already remarked; they are merely the effect of local circumstances, and arise from the small systems of attraction by which the general phenomena are modified. This must be sensible in particular for that part of America which M. Humboldt travelled over, and which is traversed throughout its whole length by the grand chain of the cordillera of the Andes. It is also in these places that the most considerable differences exist. Popayan, for example, is situated near the volcanoes of Sotara and Pourace; it is joined to basaltic mountains abounding with magnetic iron. Near Sulumito, to the east of Popayan, these basaltic columns have very striking poles: in like manner Mexico is situated at the height of 1160 toises on the ridge of the grand cordillera of Lenschtitlan; the ground there is covered with porous basaltes and amygdaloids,

Theory.

daloids, which are almoſt all charged with magnetic iron. Muſt not all theſe cauſes have a ſenſible influence on the inclination of the magnetic needle; and muſt not the different diſpoſitions of the ferruginous maſſes, or their change of ſtate, in conſequence of the action of nature, produce alſo variations? M. Humboldt made on this point a deciſive obſervation: the earthquake of the 4th of November 1799 changed at Cumana the inclination of the needle. On the 1ſt of November it was 43° 65′; on the 7th it was only 42° 75′, and ten months after it returned to 42° 85′, but it did not regain its former value; the intenſity of the magnetic force was not changed by the effect of this earthquake.

It is proved, then, by theſe obſervations, that local circumſtances may have on the inclination a ſenſible influence; and this influence is remarked in the countries traverſed by M. Humboldt.

It appears, therefore, that the mathematical hypotheſis which we have employed really expreſſes the law of nature, at leaſt to the north of the magnetic equator; for, though the firſt reſults obſerved towards the ſouth ſeem to bend to it alſo, the uncertainty under which we are, in regard to the true cauſe of theſe phenomena muſt ſtop our conjectures, and prevent us from extending too far the conſequences of the laws which we obſerve (F).

From the preceding reſults, we may calculate the points where the axis of the magnetic equator pierces the terreſtrial ſurface; for their latitudes are equal to the complements of the obliquity of that equator, and their meridian is at 100° of longitude from its nodes. The north magnetic pole is found alſo at 79° 1′ 4″ of north latitude, and at 30° 2′ 5″ of longitude weſt from Paris, which places it to the north of America. The other magnetic pole, ſymmetric to the preceding, is ſituated in the ſame latitude ſouth, and at 149° 67′ 55″ of longitude eaſt from Paris, which places it amidſt the eternal ice; indications entirely analogous to thoſe of Wilke and Lemounier.

If we could reach theſe poles, the compaſs would be ſeen vertical; but if any confidence can be placed in the law which we have diſcovered, this would be the only difference which would be obſerved in regard to the inclination, and we ſhould be ſtill as far diſtant as in Europe from the real centres which produce it. This reſult might appear to be of ſuch a nature as to diminiſh the intereſt one might have in viſiting theſe horrid regions, had we not alſo the hope of diſcovering there new phenomena in regard to the intenſity of the magnetic force, and the influence of meteors.

Theſe conſequences do not entirely accord with the opinion pretty generally received, and which aſcribes the increaſe of the magnetic effects towards the north to the great quantity of iron diſperſed throughout theſe regions; but it appears to us that this opinion is not agreeable to the truth. The cordillera of the Andes contains an enormous quantity of magnetic iron; the native iron of Chaco, that problematic maſs analogous to that of Pellas, and thoſe of Xacatares in Mexico, is found even under the tropics.

On ſeeing the inclinations of the compaſs ſo exactly repreſented in the hypotheſis, they endeavoured to diſcover whether it could be applied to the intenſities obſerved by M. Humboldt; but they found that it did not apply. It gives indeed, an increaſe of the magnetic forces from the equator to the pole; but this increaſe, which at firſt is too ſlow, becomes afterwards too rapid. M. Biot has not yet been able to try whether the ſmall diſplacement of the terreſtrial magnet will contribute towards repreſenting them better; but it muſt be remarked, that the ſeries of the intenſities is extremely whimſical, and contains an infinite number of anomalies, ſo that local phenomena may have on this phenomenon a much more ſenſible influence than on the inclination.

On reviewing the reſults which have been given, it is ſeen that we have firſt determined the poſition of the magnetic equator by direct obſervations, which had never been done before; we have then proved that the magnetic force increaſes in proceeding from that equator to the poles; in the laſt place, we have given a mathematical hypotheſis, which, when reduced to a formula, ſatisfies all the inclinations hitherto obſerved.

Suppoſing, as has been done in this formula, the ſmall corrections of which it is ſuſceptible, its utility becomes evident, either for making known, in the courſe of time, the variations which may take place in the action of the terreſtrial magnetiſm, or to aſcertain or even foreſee the value of the inclination, which in a great many caſes is of the utmoſt importance.

For example, near the magnetic equator, the increaſe or diminution of the inclination will indicate to a veſſel on a voyage whether ſhe has gained or loſt in latitude by currents. This knowledge of the latitude is ſometimes as important as that of longitude. On the coaſts of Peru, for example, the currents tend from Chiloé to the north and north-eaſt with ſuch force, that one may go from Lima to Guayaquil in three or four days, and two, three, and ſometimes five months are neceſſary to return. It is conſequently of the greateſt importance for veſſels coming from Chili which ſtretch along the coaſt of Peru, to know their latitude. If they go beyond the port to which they are bound, they muſt work to the ſouthward, and every day's progreſs requires often a month of return. Unfortunately, the fogs which prevail during four or five months on the coaſt of Peru, prevent

(F) Obſervations made at the Cape of Good Hope, Cape Horn, and New Holland, by different navigators, are very exactly repreſented by the above-mentioned formula; and it follows, that it extends alſo to the auſtral hemiſphere. We hope ſoon to have numerous and very exact obſervations on the inclination of the needle in that part of the earth. But we have thought it our duty to add to our table ſuch reſults as relate to it, and which we have been able to procure. We have inſerted alſo two obſervations on the intenſity, made with great care by M. Roſſel, during the expedition of d'Entrecaſteaux, which are very important, as they prove that the terreſtrial magnetic force increaſes alſo in the auſtral hemiſphere in proportion as one removes from the equator.

Theory.

prevent navigators from diftinguifhing the form of the coaft; nothing is feen but the fummits of the Andes, and that of the peaks which rife above that ftratum of vapours; but the figure of it is fo uniform that pilots fall into miftakes. They often remain 12 or 15 days without feeing the fun or ftars, and during that interval they come to anchor, being afraid of overfhooting their port; but if we fuppofe that the inclination of the magnetic needle in the ports to the fouth of Lima is known, for example at Chancay, Huaura, and Santa, the dipping needle will fhow whether it be, in regard to Lima, to the fouth or to the north. It will fhow at the fame time oppofite what point of the coaft a veffel is; and this indication will be attended with more exactnefs than one could hope for, becaufe in thefe feas the inclination varies with extraordinary rapidity. M. Humboldt, to whom we are indebted for thefe remarks, obferved in thefe feas the following values.

Places.	*South Latitudes.*	*Inclinations.*
Huancey	10° 4′	6.80°
Huaura	11 3	9.00
Chancay	11 33	10.35

Thefe obfervations prove that the error of three or four degrees in the inclination in thefe feas would produce but a degree of error in latitude; and, on account of the tranquillity of the Pacific ocean, the inclination may be obferved to within a degree nearly. Frequent inftances of fuch refults may be feen in books of voyages. In like manner, if one knew exactly the inclination at the mouth of the Rio de la Plata, it would be very ufeful to navigators, who, when the Pamperos blow, remain 15 or 18 days without feeing the heavenly bodies, and go on different tacks for fear of lofing the parallel of the mouth of that river.

In a word, the inclination may indicate alfo the longitude in thefe feas; and this method may be employed when others fail. A veffel which fails there in the direction of a parallel could not find its longitude either by a chronometer or the declination of Halley, unlefs a ftar could be feen, in order to take an horary angle or the magnetic azimuth. The dipping needle then throws light on the longitude amidft the thickeft fogs. We point out this method as one of thofe which have only a local application; but hitherto little attention has been paid to it. Thefe ideas may be extended and rectified by able navigators.

In general, if the inclination of the needle, and the law we have tried to eftablifh, could be depended on, to obferve the inclination and the terreftrial latitude would alfo be fufficient to determine the longitude; but we have not yet examined the extent of the errors of which this method may be fufceptible, and confequently we confine ourfelves to a mere indication of it.

The phenomenon of the inclination has in maritime obfervations a peculiar and very remarkable advantage, namely, that of not being fubject to thofe great progreffive variations which affect the declination. Without repeating what we have already faid above on the fuppofed conftancy of this phenomenon, it may be remarked that our formula even affords a new proof that it may comprehend in the fame law the obfervations made many years ago in Lapland, thofe which Lacaille brought back in 1751 from the Cape of Good Hope, and thofe which M. Humboldt has lately made in America.

In fhort, when we tried to reprefent the inclinations in different latitudes by the fuppofition of a magnet infinitely fmall, very near the centre of the earth, and perpendicular to the magnetic equator, we did not pretend to confider that hypothefis as any thing real, but only as a mathematical abftraction ufeful to connect the refults, and proper to afcertain in future whether any changes exift. In regard to the declination and intenfity, we freely confefs that we are entirely unacquainted with their laws or their caufes; and if any philofopher is fo fortunate as to bring them to one principle, which explains at the fame time the variations of the inclination, it will no doubt be one of the greateft difcoveries ever made. But this refearch, exceedingly difficult, requires, perhaps, before it be attempted, more obfervations, and in particular more precife obfervations, than have hitherto been collected. For this reafon we have prefented the preceding refearches, imperfect as they are, hoping our readers will receive them with indulgence *.

* Phil. Mag. vol. xxii.

We would willingly have entered into a more full illuftration of the theory of Æpinus, and compared it with the phenomena noticed in CHAP. II. but the important paper juft given has taken up fo much room, that this article is already extended to very nearly the utmoft limits affigned to it. We muft therefore content ourfelves with giving fome idea of the induction of magnetifm by juxtapofition according to Æpinus's hypothefis, and muft refer for the reft to his *Tentamen Theoriæ Electricitatis et Magnetifmi*, or to the abridgement of it in Van Swinden's work *Sur l'Analogie de l'Electricité et du Magnetifme*, tom. ii. 101

Induced magnetifm by juxtapofition explained.

Let NAS (fig. 31). be a magnet, of which the part next the north pole AN is overcharged, and let a bar of iron s B n be brought near the north pole of the magnet, fo that their axes are in the fame ftraight line. Now, in this theory, the overcharged pole N acts on the iron only by its redundant fluid, for that part of the fluid which is merely fufficient to faturate the iron will repel the fluid in B as much as the iron in AN attracts it, and of courfe can produce no change in B. In the fame way SA acts on B merely by its redundant iron. Now, were the fluid in s B n immoveable, no fenfible effect would be produced on it; but as it is fuppofed to be eafily moveable, the redundant fluid in AN will have the effect of repelling it towards n, till the refiftance met with there, added to its own tendency to diffufe itfelf uniformly, juft balances the repulfion of AN. In the mean time, however, an attraction exifts between the redundant iron in AS, and the fluid in B, by which the latter would be drawn from B n, and condenfed in B s, the attraction oppofing the repulfion above mentioned; but fince AS is more diftant from every point of B than AN from the fame point, the redundant fluid will prevail, and on the whole the fluid will be condenfed towards n, and rarefied towards s. The more diffufed we fuppofe the fluid and iron in the magnet to be, the more removed will be the centres of effort of its poles from their extremities, the fmaller will be the action, and the difference of action of AN and AS, and of courfe the fmaller the condenfation towards n, and the rarefaction towards s. From this we learn, that 102

Theory.

that, according as the poles of a magnet are more counteracted, the greater will be its power of action; and as this is agreeable to observation, it gives additional credit to the hypothesis.

Now, we see that the piece of iron n B s is attracted in consequence of its fluid being repelled towards its remote extremity, and distributed something like the fluid in NAS. In this hypothesis magnetism is supposed to depend entirely on the diffusion of magnetic fluid. The iron B has become a magnet, and by having magnetism induced on it, is attracted by the magnet A. In a similar way we might explain the action of the magnet, if its south or deficient pole were presented opposite to B.

103 Coulomb's theory.

When the notion of a magnetic fluid was once entertained, it is not surprising that philosophers, reasoning from the analogy between electricity and magnetism, and the different effects arising from the south and north pole of a magnet, should be led to the idea of the magnetic fluid being compounded of two fluids. Accordingly the hypothesis of two magnetic fluids has long been a favourite on the continent, where it has been chiefly supported by Coulomb and Haüy. As the experiments and observations of the former philosopher entitle him to the highest respect, we shall here give a sketch of his theory of magnetism.

1. Coulomb admits of two magnetic fluids, one of which may be called the northern, and the other the southern fluid.

2. The particles of each of these two fluids are mutually repulsive of each other; that is, the particles of the fluid N mutually repel each other, and the particles of the fluid S repel each other.

3. There is a mutual attraction between the particles of one of these fluids and the particles of the other; or the particles of the fluid N attract and are attracted by the particles of the fluid S.

4. In the ordinary state of iron not magnetized, these two fluids are found mixed together, and hence a piece of ordinary iron under the usual circumstances exhibits no signs of magnetism.

5. In a magnetized body these two fluids are separated, and this separation takes place as soon as we begin to magnetize the body; one of the fluids N, retiring towards one extremity, and the other fluid S to the other extremity of the magnetized body.

6. The attraction and repulsion of two magnetic bodies, when they approach each other, is the result of the mutual action of the two fluids.

Suppose we have two needles A and B. If we make them approach each other on the side of the two poles of the same name, N or S, they will repel each other; but if they are made to approach on the side of different poles, as when the needle A presents its north pole to the south pole of the needle B, they will attract each other. Here there are four forces in action; 1. the fluid N of the needle A repels the fluid N of the needle B. 2 The same fluid N of the needle A attracts the fluid S of the needle B. 3. The fluid S of the needle A repels the fluid S of the needle B; and 4. The fluid S of the needle A attracts the fluid N of the needle B. Now, if the extremity N of the needle A be very near the extremity S of the needle B, the mutual attraction between the two fluids N and S, will be stronger than the mutual repulsion between the two fluids N, N, and the two fluids S, S, and consequently the two needles will approach each other.

Theory.

7. The attraction and repulsion of the two magnetic fluids is in the direct ratio of the masses, and in the inverse ratio of the distances.

This important part of the theory Coulomb deduces from a series of very delicate experiments made with his magnetic bars, similar to those by which he proved the same law to take place with respect to the action of the electric fluid. See ELECTRICITY, Part IV. chap. ii.

8. The magnetic fluid is entirely in the interior of magnetic bodies, for as the magnetic fluid moves with difficulty in the interior of a magnetic body, it cannot diffuse itself over the surface, which is the reason why filings of iron brought near a magnetic bar, remain attached to it.

9. Consequently magnetic bodies can have no magnetic atmosphere.

10. In a magnetic needle, the centres of magnetic action are near the extremities of the needle.

11. A magnetic needle being broken in any place, each of its parts is found to have two poles.

12. The forces which attract a needle towards one pole, are equal to those which draw it toward the other pole.

13. Magnetic bodies do not act on other bodies susceptible of magnetism, in any other way than by attraction or repulsion; for the magnetic fluid remains entirely within the interior of these bodies.

14. Magnetic attraction ought to be regarded as a particular power, analogous, however, to the power which we call universal gravitation, the only difference being, that gravitation acts very sensibly on all bodies, whereas magnetism acts most powerfully on iron.

15. This magnetic power or attraction is therefore a particular power produced neither by impulsion, nor by the action of any other fluid.

Though the instrument which is usually employed to measure the inclination of the magnetic needle is very simple in its construction, it is nevertheless liable to great errors, which in general arise from the almost absolute impossibility of placing the needle in all the positions it can take in equilibrium with regard to the effect of gravitation, that is to say, so that its centre of gravity may always exactly agree with the point on which it turns. When the dimensions are considerable, a new inconvenience arises from a degree of flexure, which, though scarcely sensible, is nevertheless productive of very great effects from the slightest displacement of the centre of gravity producing a combination of the power of gravitation with that of magnetism. 104 Coulomb's mode of ascertaining the magnetic dip.

To obviate these difficulties, Citizen Coulomb, instead of endeavouring to ascertain immediately, as has been hitherto done, the direction of the magnetic needle in the vertical plane which passes through the magnetic pole, conceives the force of this pole to be decomposed or resolved into two others in the same plane, the one acting in a horizontal, and the other in a vertical direction. He determines separately the intensity of each of these last forces, and the result gives the direction in which the magnetic force acts, and which a needle governed singly by this force would take.

Citizen

Theory.

Citizen Coulomb has proved, in the Memoirs of the Academy of Sciences for the year 1789, that the magnetic needle ſuſpended by its centre of gravity is inceſſantly brought back to its true direction by a conſtant force at the ſame place and time. It thence follows, that by obſerving the number of oſcillations made in a given time by a needle horizontally ſuſpended, the ratio of the horizontal component part of the magnetic power with gravity may be obtained. As to the vertical component part, it is meaſured by determining with care the weight neceſſary to be added to the ſouthern part of the magnetic needle, to maintain it in a perfectly horizontal poſition. That being done, if A and B repreſent the reſpective meaſures of the horizontal and vertical component parts of the magnetic power, $\frac{B}{A}$ will be the tangent of the angle made by their reſult with the horizontal force, and conſequently, it will be the inclination of the magnetic needle.

In the experiments made by Citizen Coulomb, the needle had the form of a right-angled parallelopipedon, very thin in proportion to its breadth, and always ſuſpended ſo that its breadth was kept in a vertical plane. Let P repreſent the weight of the needle, l the half of its length, λ the length of a pendulum that performs its oſcillations in the ſame time as the needle when it obeys the magnetic power in a horizontal plane. Coulomb then gives the formula $\frac{P l^2}{3 \lambda}$ to calculate the momentum of the magnetic force referred to the arm of a lever of one millimeter in length. The length of the needle was 427 millimeters, its breadth 13, and its weight 88,753 milligrammes. It was ſuſpended horizontally by a thread of ſilk in a box well cloſed, and it made 30 oſcillations in 286 ſeconds, and by applying theſe data to the preceding formula, Coulomb found that the logarithm of the momentum of the horizontal magnetic force is 4.1740.

Coulomb having placed his needle in a clip, having knife edges, which reſted on two cylinders of glaſs, in the manner of the beam of a balance, endeavoured firſt to bring it to an equilibrium in a horizontal ſituation coinciding with the magnetic meridian, by placing the edges in a proper manner, and when they were ſufficiently near the point where the equilibrium took place, he completed it by the addition of ſmall weights. He then reverſed the poles of the needle by the magnetic touch, but without altering the poſition of the clip, and again bringing it to an equilibrium in this new ſtate, the ſum of the momenta of the additional weights placed in theſe two operations gave him the double of the momentum of the vertical component parts of the magnetic force, valued at $\frac{74467}{2}$. The reſult of this force, and of the horizontal force, is inclined 68° 9′.

In repeating theſe operations three times, Coulomb found ſucceſſively 68° 9′, 68° 13′, and 68° 11′. Though the differences of theſe reſults are very trifling, he thinks they are to be entirely attributed to errors in the obſervation; for he is aſſured they do not amount to ſo much. It is poſſible that the needle is ſubject to variations in the vertical ſimilar to thoſe which are known to take place in the horizontal plane.

105 Bernoulli's dipping needle.

Daniel Bernoulli contrived an ingenious dipping needle that may anſwer the purpoſe of an univerſal inſtrument for making accurate obſervations on the dip. It depends on the following principle. If a dipping needle be made by an ordinary workman, and balanced with ſome care, ſo that when impregnated with magnetiſm, it may ſhow nearly the true dip, and if it be touched, and the dip obſerved, then its magnetiſm deſtroyed, and its balance ſo altered, that without any magnetiſm it will take nearly the inclination of the true dip; and if it be then touched again, giving it the ſame polarity as it had before, it is evident that it will now approach very nearly to the true dip, ſince, by its want of perfect equilibrium it was deranged only a few degrees from its proper direction. If the ſecond obſervation of the dip ſhould, from the inaccurate formation of the needle, differ conſiderably from the firſt, the operation muſt be repeated; and in this third obſervation there will very ſeldom be an error of more than half a degree.

Bernoulli's inſtrument is as follows. A very light graduated braſs circle EFG (fig. 32.) is fixed on one ſide of the dipping needle, ſo as to be concentric with its axis, and the whole is balanced with as much nicety as may be, before being impregnated. CD is a very light index fixed to the axis in ſuch a manner as to turn on it with ſome difficulty. By this the equilibrium of the needle will be deſtroyed. If great care has been taken in forming the inſtrument, and if it has been balanced with great accuracy, it will, by the addition of the index, be made to ſettle ſo as to have the index perpendicular to the horizon, at whatever degree of the circle the needle may happen to point. As ſuch accuracy, however, is ſcarcely to be expected, let the index be ſet to ſeveral different degrees of the circle, and note the inclination taken by the needle before being magnetized, correſponding to each poſition of the index, and let all theſe be written down. For example, let us ſuppoſe that when the index is at 50°, the needle inclines 46° from the horizon; if we obſerve at any place that the needle, after being magnetized, inclines 46°, when the index is at 50°, we may be ſure that the former is the true magnetic dip at that place, as the needle is not deranged by the magnetiſm that has been given it, from the ſituation it would aſſume by gravity alone. We uſually know ſomething of the dip that may be expected at any place. If we ſet the index accordingly, and if the needle does not then point out the expected dip, change the poſition of the index, and again obſerve the dip; examine whether this ſecond poſition of the index and the ſecond dip form a correſponding pair of numbers, ſuch as we have written down; if they do, we have got the true dip, but if not, another poſition of the index muſt be tried. Thus, by noticing whether the agreement of this laſt pair be greater or leſs than that of the former pair of numbers, we learn whether we are to change the poſition of the index in the ſame or in the oppoſite direction.

106 Analogy between electricity and magnetiſm.

A cloſe analogy has long been remarked between the phenomena of magnetiſm and thoſe of induced electricity, eſpecially thoſe of attraction and repulſion. The mechanical compoſition of theſe actions produces a directive power and polarity, both in electrical and magnetical bodies. It is eaſy to form an electrical needle that will arrange itſelf with reſpect to the overcharged and undercharged ends of a body electrified by poſition, juſt as a magnetic

Theory.

magnetic needle arranges itſelf with reſpect to the magnet. A ſtick of ſealing wax may be touched in a manner ſimilar to the double magnetic touch, ſo as to acquire poles of conſiderable force, and very durable. Again, melted ſealing wax, when cooled in the neighbourhood of a poſitive and negative electric, acquires permanent poles, juſt as a red hot ſteel bar acquires them by being quenched near a magnet. Laſtly, lightning ſometimes gives polarity to needles, ſometimes deſtroys it, and ſometimes reverſes their polarity.

From theſe various circumſtances of reſemblance, ſome have ſuppoſed that both phenomena originate from the ſame cauſe, but there are ſeveral circumſtances which ſhow their original cauſes to be different. Thus, we find that electricity is common to all bodies, and can be excited or induced on all in a degree that is pretty nearly equal. Magnetiſm, on the contrary, though from Coulomb's experiments, it appears in ſome degree to affect all terreſtrial bodies, acts, however, very imperceptibly on all but iron and its compounds. The action of lightning muſt not be conſidered as a proof of their identity, ſince that is accompanied with a great degree of heat, and we have already ſeen that this power, under favourable circumſtances, is a very active agent, both in producing and deſtroying magnetiſm. Again, there is nothing in magnetiſm like a body being entirely overcharged, or entirely undercharged, as in electricity; but a magnetic body having two poles, muſt always be overcharged at one extremity, and undercharged at the other. There is nothing in magnetiſm reſembling that inconveivably rapid motion which we ſee in electricity. In fine, the only perfect reſemblance is between the induced magnetiſm of common iron, and the induced electricity of a conductor. On the arguments that have been employed for and againſt the identity of magnetiſm and electricity, our readers may conſult Van Swinden, *Sur l'Analogie de l'Electricité, et du Magnetiſme*, and a tract by Æpinus *De Similitudine Electricitatis et Magnetiſmi.*

Some late experiments of Ritter tend to ſhow a greater analogy than has yet been ſuppoſed, between magnetiſm and that modification of electricity which we call galvaniſm.

107 Ritter's experiments.

Mr Ritter's firſt experiments with the magnet were on frogs. He found that a magnetic iron wire, with another not magnetic, excited a galvanic palpitation in theſe animals. Preſently he obſerved, that the ſouth pole excited ſtronger palpitations, and the north pole weaker, than the iron not magnetic. Having conſtantly noticed, that the metals moſt ſuſceptible of oxidation excited the ſtrongeſt palpitations, he inferred, that the ſouth pole poſſeſſes a greater affinity for oxygen than ſimple iron, and the north pole leſs.

This ſuppoſition he confirmed by means of ſeveral chemical re-agents. He placed a magnetic iron wire on pieces of glaſs in a plate of earthen ware, and poured upon it a very weak nitric acid. The ſouth pole was attacked by the acid much more powerfully than the north; and was ſoon ſurrounded by a depoſition of oxygen, the quantity of which greatly exceeded that of the other pole.

The different oxidability of the magnetic poles is very well exhibited likewiſe, by taking three ſmall bottles of equal ſize, filled with water, either pure or ſlightly acidulated, and putting into one the ſouth polar end of a magnetic wire, into a ſecond the north polar end of a ſimilar wire, and into the third the end of an equal wire not magnetic; the ſouth pole will firſt begin to depoſit oxide, the unmagnetic iron a little after, and the north pole laſt. This experiment requires conſiderable care. The ſurface of the water muſt be covered with very freſh oil of almonds, to exclude all acceſs of air. Care muſt be taken too, that one of the bottles is not more expoſed to the ſun than the others, becauſe light accelerates oxidation. Ritter convinced himſelf of this by direct experiments; expoſing two iron wires in water to the ſun, but covering one of the phials with black paper, when that in the phial left uncovered was oxidated much more quickly.

If infuſion of litmus be ſubſtituted inſtead of the water in the three phials in the preceding experiment, the relative oxidations will be the ſame, but they will be attended with a change of colour, ſhowing that an acid is produced proportional to each oxidation; ſo that the ſouth pole not only undergoes the greateſt oxidation, but likewiſe reddens the infuſion of litmus moſt. The action that takes place in this experiment is very feeble, and frequently requires a week to produce a diſtinct effect; and indeed to accelerate it ſo much as this, it is neceſſary to add, previouſly to the infuſion, as much acetic acid as will incline it to red, without completely changing its colour. The infuſion reddened in this experiment reſumes its blue colour on expoſure to the air; but we muſt not hence conclude, that the acid produced by the action of the magnet is very volatile, for infuſion of litmus reddened by phoſphoric acid, or any other, exhibits the ſame phenomenon.

The following experiment exhibits ſome things peculiar, and therefore we ſhall give it more at large. It has not been repeated, but the harmony of its reſults is in favour of its accuracy. Sixteen magnetic wires, of equal ſize and power, were placed in ſix veſſels, all equally full of a mixture of one part nitric acid, and 36 parts water, in the following manner: in the firſt glaſs were placed two wires, one with the north pole immerſed in the fluid, the other with the ſouth, and not more than half a line aſunder: in the ſecond, the ſame, but the wires an inch and three-fourths apart: in the third and fourth were each three wires, with the ſouth poles of all immerſed, but their diſtances in the two glaſſes different, as in the firſt and ſecond: in the fifth and ſixth were wires ſimilarly arranged, but with the north poles immerſed. Different quantities of oxide were gradually depoſed, and to expreſs the whole in few words, we will call the ſouth pole S, the north pole N, their greater diſtance g, and their leſs p, and we will expreſs the order of oxidations as follows: $SNg > SNp > 3\,Sp > 3\,Sg > 3\,Np > 3\,Ng >$. On the nineteenth day it was obſerved, that the loſs of fluid by evaporation had not been equal in all the veſſels, but took place in the inverſe order of the oxidations. All the magnetic wires were weakened in power; NSg leaſt; NSp more: of the wires $3\,Sp$, two had loſt leſs power than the third; and in like manner $3\,Sg$, $3\,Np$ $3\,Ng$, had each two left more powerful than the third; the ſtrongeſt were equal to NSg.

In another experiment, where two little veſſels filled with infuſion of litmus were employed, one of them containing two magnetic wires, the ſouth poles of which were immerſed in the fluid; the other two ſimilar wires, of

Fig. 14.

Fig. 15.

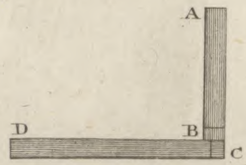


Fig. 16.

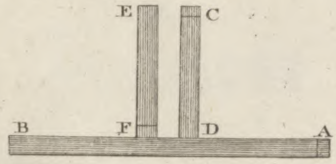


Fig. 17.

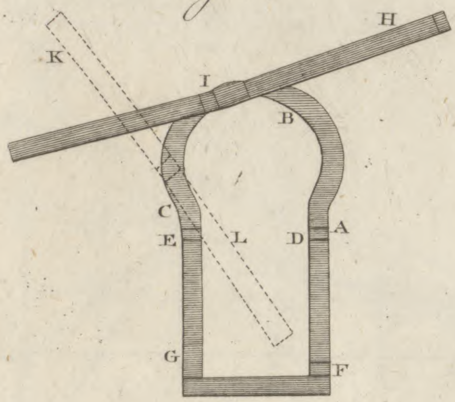


Fig. 18.

Fig. 19.

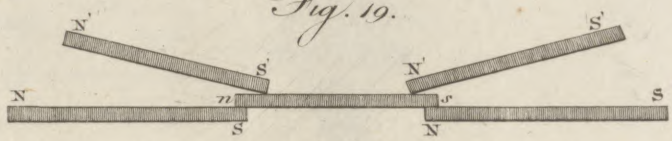
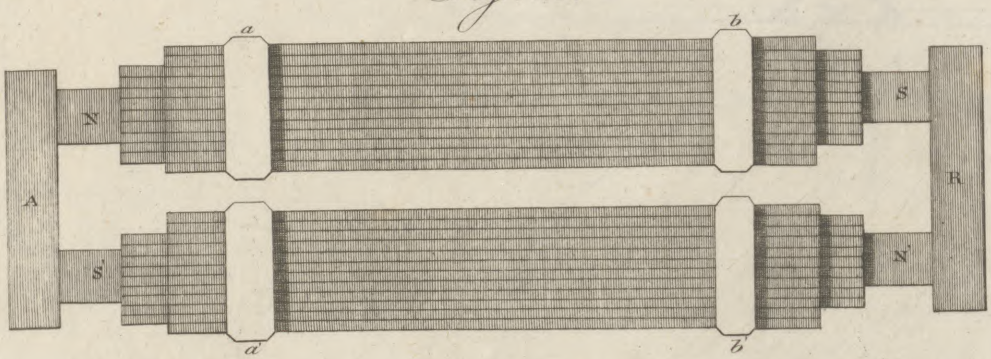


Fig. 20.



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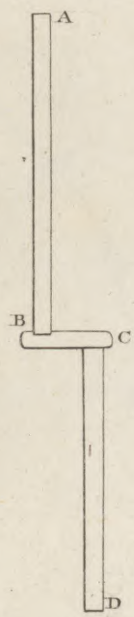

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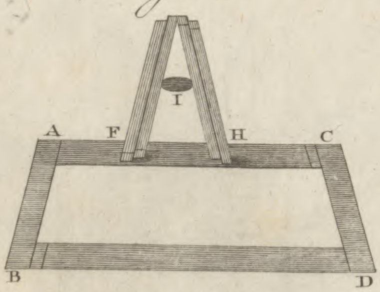
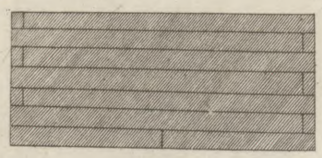


Fig. 22.



A.Bell Prin. Wal. Sculptor fecit.

Fig. 24.

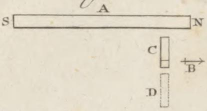


Fig. 25.

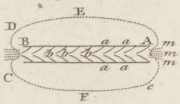


Fig. 26.

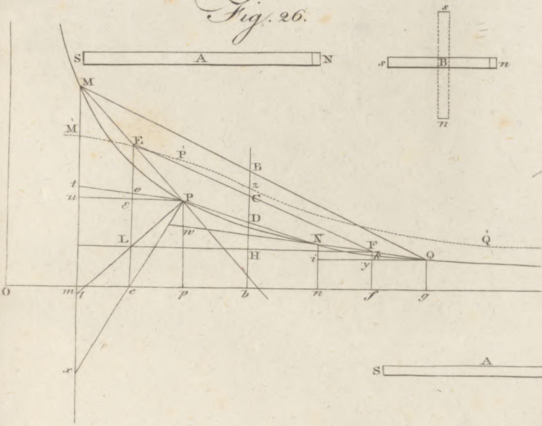


Fig. 27.

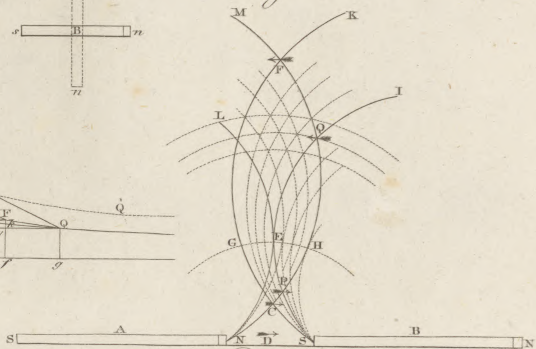


Fig. 28.

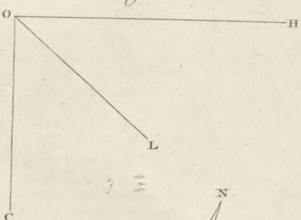


Fig. 29.

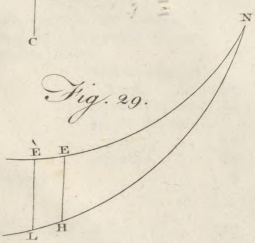


Fig. 30.

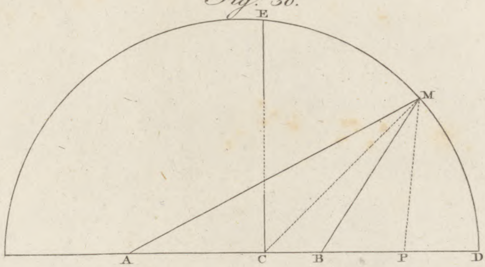


Fig. 31.

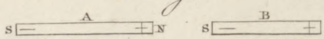
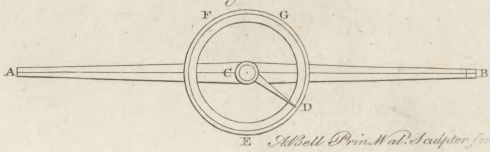


Fig. 32.



A. Bell Prin. Wal. Sculptor fecit

Theory.

of which the opposite poles were immersed; the oxidation was greatest in the latter vessel.

The analogy between galvanism and magnetism is still farther proved by other experiments of Ritter on *galvanizing* metals, which he does by placing them in a stream of galvanic fluid proceeding from a strong pile. He found that a golden needle thus galvanized and balanced on a pivot, exhibited, like a magnetized iron needle, both directive power and horizontal inclination.

Some late experiments of Ritter, referring still more directly to the analogy between magnetism and galvanism, were communicated to the Royal Academy of Sciences of Munich, and the following are their general results.

1. Every magnet is equivalent to a pair of heterogeneous metals united together; its different poles represent as it were different metals.

2. Like them, it gives electricity; that is to say, one of the two poles, the positive electricity, and the other the negative.

3. By following the same process, a certain number of magnets, as well as a certain number of pairs of metals, afforded electricity; and in this manner the electricities afforded by the poles of different magnets, have been successfully indicated by the electrometer.

4. By means of these electricities, one of these batteries of magnets, accordingly as it is more or less strong, produces upon dead and living bodies, all the phenomena which are produced by a pile of Volta, of the common kind, and of the same force.

5. The experiments which prove this, show, that in magnetized iron, the south pole gives positive electricity, and the north pole negative electricity; but that on the contrary in magnetized steel, the north pole affords the positive, and the south pole the negative.

6. The same inverse disposition is also observed with regard to the polar oxidability of the magnetized body in which this change is produced by magnetism. In magnetized iron the south pole is most oxidable, and the north pole least; whereas in magnetized steel the north pole is most oxidable, and the south least.

7. Mr Ritter thinks, that by considering the earth as an immense magnet, these results might serve to explain various phenomena of nature, such as the physical difference between the two hemispheres, the aurora borealis and aurora australis. In fact, after what has been just stated, the earth considered as a magnet, may be taken as an equivalent to an immense pile of Volta, of which the poles are on one side sufficiently closed by the waters of the ocean. And the action of this pile must produce, and has produced the greatest chemical changes in the materials of the earth; changes which must have differed according to the poles; and of which pile the poles at the other extremity have always such an abundance of electricity as to cause its splendour to appear by radiations in the vast spaces of the heavens*.

The foregoing experiments appear to prove that magnetism has some effect in producing chemical changes, and thence we may infer that perhaps it would not be altogether inactive in the animal economy.

Nicholson's Journal. xv. 78.

ERRATUM.—Page 376, column 2d. line 19. in some copies, *for* without its being necessary to observe that, *read* without its being necessary to rub them with the upper pair. When magnets of greater force are desired.

INDEX.

Experiments,

Animal Magnetiſm.

Animal MAGNETISM, a ſympathy ſuppoſed by ſome perſons to exiſt between the magnet and the human body; by means of which the former, it was thought, poſſeſſed the property of curing many diſeaſes.

The notion of animal magnetiſm appears to have originated, in 1774, with a German philoſopher named *Father Hehl*, who greatly recommended the uſe of the magnet in medicine. M. Meſmer, a phyſician of the ſame country, by adopting the principles of Hehl, became the direct founder of the ſyſtem; but, afterwards deviating from the tenets of his inſtructor, he loſt his patronage, as well as that of Dr Ingenhouſz, which he had formerly enjoyed. Meſmer had already diſtinguiſhed himſelf by "A diſſertation on the influence of the Stars upon the human body," which he publicly defended in a theſis before the univerſity of Vienna; but he he was ſo unable to ſtand before the oppoſition of Hehl and Ingenhouſz, that his ſyſtem fell almoſt inſtantly into diſrepute. Meſmer appealed to the Academy of Sciences at Berlin; but they rejected his principles as deſtitute of foundation, and unworthy of the ſmalleſt attention. He then made a tour through Germany, publiſhing everywhere the great cures he performed by means of his animal magnetiſm, while his enemies everywhere purſued him with detections of the falſehood of his aſſertions.

Meſmer, ſtill undaunted by ſo many defeats, returned to Vienna; but meeting there with no better ſucceſs than before, he retired to Paris in the beginning of the year 1778. Here he met with a very different reception. He was firſt patronized by the author of the *Dictionnaire des Merveilles de la Nature;* in which work a great number of his cures were publiſhed, Meſmer himſelf receiving likewiſe an ample teſtimony of his candour and *ſolid reaſoning*. Our phyſician ſoon collected ſome patients; and in the month of April 1778 retired with them to Creteil, from whence he in a ſhort time returned with them perfectly cured. His ſucceſs was now as great as his former diſappointment. Patients increaſed ſo rapidly that the doctor was ſoon obliged to take in pupils to aſſiſt him in his operations. Theſe pupils ſucceeded equally well as Meſmer himſelf; and ſo well did they take care of their own emolument, that one of them named M. Deſlon realized upwards of 100,000l. ſterling. In 1779 Meſmer publiſhed a memoir on the ſubject of Animal Magnetiſm, promiſing afterwards a complete work upon the ſame, which ſhould make as great a revolution in philoſophy as it had already done in medicine.

The new ſyſtem now gained ground daily; and ſoon became ſo faſhionable, that the jealouſy of the faculty was rouſed, and an application concerning it was made to government. In conſequence of this a committee was appointed to inquire into the matter, conſiſting partly of phyſicians and partly of members of the Royal Academy of Sciences, with Dr Benjamin Franklin at their head. This was a thunderſtroke to the ſupporters of the new doctrine.——Meſmer himſelf refuſed to have any communication with the committee; but his moſt celebrated pupil Deſlon was leſs ſcrupulous, and explained the principles of his art in the following manner:

1. Animal magnetiſm is an univerſal fluid, conſtituting an abſolute plenum in nature, and the medium of all mutual influence between the celeſtial bodies, and betwixt the earth and animal bodies.

2. It is the moſt ſubtle fluid in nature; capable of a flux and reflux, and of receiving, propagating, and continuing all kinds of motion.

3. The animal body is ſubjected to the influences of this fluid by means of the nerves, which are immediately affected by it.

4. The human body has poles and other properties analogous to the magnet.

5. The action and virtue of animal magnetiſm may be communicated from one body to another, whether animate or inanimate.

6. It operates at a great diſtance without the intervention of any body.

7. It is increaſed and reflected by mirrors; communicated, propagated, and increaſed by ſound; and may be accumulated, concentrated, and tranſported.

8. Notwithſtanding the univerſality of this fluid, all animal bodies are not equally affected by it; on the other hand, there are ſome, though but few in number, the preſence of which deſtroys all the effects of animal magnetiſm.

9. By means of this fluid nervous diſorders are cured immediately, and others mediately; and its virtues, in ſhort, extend to the univerſal cure and preſervation of mankind.

From this extraordinary theory, Meſmer or M. Deſlon, had fabricated a paper, in which he ſtated that there was in nature but one diſeaſe and one cure, and that this cure was animal magnetiſm: and laſtly, M. Deſlon engaged, 1. To prove to the commiſſioners, that ſuch a thing as animal magnetiſm exiſted; 2. To prove the utility of it in the cure of diſeaſes; after which he was to communicate to them all that he knew upon the ſubject. The commiſſioners accordingly attended in the room where the patients underwent the magnetical operations. The apparatus conſiſted of a circular platform made of oak, and raiſed about a foot and a half from the ground; which platform was called the *baquet*. At the top of it were a number of holes, in which were iron rods with moveable joints for the purpoſe of applying them to any part of the body. The patients were placed in a circle round, each touching an iron rod, which he could apply to any part of the body at pleaſure; they were joined to one another by a cord paſſing round their bodies, the deſign being to increaſe the effect by communication. In the corner of the room was a piano forte, on which ſome airs were played, occaſionally accompanied with a ſong. Each of the patients held in his hand an iron rod ten or twelve feet long; the intention of which, as Deſlon told the commiſſioners, was to concentrate the magnetiſm in its point, and thus to render its effects more ſenſible. Sound is another conductor of this magnetiſm; and in order to communicate the magnetiſm to the piano forte, nothing more is neceſſary than to bring the iron rod near it. Some magnetiſm is alſo furniſhed by the perſon who plays it; and this magnetiſm is tranſmitted to the patients by the ſounds. The internal part of the platform was ſaid to be ſo contrived as to concentrate the magnetiſm, and was the reſervoir whence the virtue diffuſed itſelf among the patients. Its ſtructure, however, is not mentioned; but the committee ſatisfied themſelves, by means of a needle and electrometer, that neither common magnetiſm nor electricity was concerned.

Beſides the different ways of receiving the magnetiſm already mentioned, viz. by the iron, cord, and piano forte, the patients alſo had it directly from the doctor's finger, and a rod which he held in his hand, and which he carried about the face, head, or ſuch parts of the patient as were diſeaſed; obſerving always the direction of what he called the poles. The principal application of magnetiſm, however, was by preſſure of the hands or fingers on the hypochondria or lower regions of the ſtomach.

The effects of theſe operations upon Deſlon's patients were very different. Some felt nothing, neither had the magnetiſm any effect whatever upon them.

Some

Some ſpit, coughed, ſweat, and felt, or pretended to feel, extraordinary heats in different parts of the body. Many women, but very few men, had convulſions, which Deſlon called their criſis, &c.—The commiſſioners at laſt found that they could come to no ſatisfactory concluſion while they attended in this public way, and therefore determined to try the experiments themſelves privately. As the fluid itſelf, however, was totally imperceptible by any of the ſenſes, they could only aſcertain themſelves of its exiſtence by ultimately curing diſeaſes, or by its obſervable effects upon the human body. Being well aſſured, however, that though many diſeaſes were cured, it would not amount to any proof of the exiſtence of animal magnetiſm, they determined to obſerve its effects on the animal economy. For this purpoſe they made the following experiments:

1. They tried it upon themſelves, and felt nothing.

2. Seven of Deſlon's patients were magnetized at Dr Franklin's houſe, four of whom felt nothing; three felt, or affected to feel, ſomething.

3. Several perſons in a higher ſphere of life were magnetized, and felt nothing.

4. The commiſſioners, now determined to diſcover what ſhare imagination had in this buſineſs, blindfolded ſeveral of the common people, and made them ſometimes think that they were magnetized, at other times they magnetized them without letting them know that they did ſo: the conſequence was, that when they ſuppoſed themſelves magnetized, the patients likewiſe thought they felt ſomething, and *vice verſa*.

5. A magnetized tree was ſaid to produce convulſions; a young man, blindfolded, fell into convulſions when he imagined himſelf near the tree, though he was really at a conſiderable diſtance from it. Deſlon accounted for this on the principle of all trees being magnetic: but in this caſe, every one, ſuſceptible of magnetiſm, would be ſeized with convulſions when he approached a tree. The ſame influence of imagination was obſerved in a woman accuſtomed to have convulſions when magnetized. They came on when nothing was done to her, on being told, when blinded, that ſhe was magnetized.

Other inſtances are given, from which it was evident, either that the patients were impoſtors, or in ſuch a moſt wretched ſtate of debility both of mind and body, that the moſt trifling effects of the former had the moſt powerful effects on the latter. The commiſſioners therefore entirely diſapproved of the whole. The touch, imitation, and imagination, they concluded, were the great cauſes of the effects produced by M. Deſlon's operations; and by means of theſe they ſuppoſed, that convulſions, which in themſelves are a very violent diſorder, might be ſpread much farther than could be wiſhed, even through a whole city. It was obſerved that the operator ſometimes preſſed ſtrongly, and for a length of time, upon different parts of the body, particularly the hypochondria and pit of the ſtomach; and it is well known that a ſtrong preſſure on theſe parts will produce diſagreeable ſenſations in thoſe who enjoy perfect health.

It is needleſs to add more upon this ſubject, than that Meſmer complained of the report of the commiſſioners, petitioned parliament, was by them commanded to diſcover the myſteries of his doctrine; and that it is now exploded by every man of ſenſe.—The concluſion of the academicians concerning it was, that it is not entirely uſeleſs even to philoſophy; as it is one *fact* more to be conſigned to the hiſtory of the errors and illuſions of the human mind, and a ſignal inſtance of the power of imagination.

MAGNIFYING, the making of objects appear larger than they would otherwiſe do; whence convex lenſes, which have the power of doing this, are called *magnifying glaſſes*. See OPTICS.

MAGNITUDE, whatever is made up of parts locally extended, or that has ſeveral dimenſions; as a line, ſurface, ſolid, &c.

MAGNOLIA, the LAUREL-LEAVED TULIP TREE, a genus of plants belonging to the polyandria claſs; and in the natural method ranking under the 52d order, *Coadnatæ*. See BOTANY *Index*.

MAGNUS CAMPUS, in *Ancient Geography*, a tract lying towards Scythopolis, or Bethſan in Galilee, beyond which it extends into Samaria; Joſephus placing the common boundary between theſe two diſtricts in the Campus Magnus. Called alſo *Eſdrelon*, (Judith); 30 miles long, and 18 broad; having Samaria with Mount Ephraim to the ſouth, the lake Geneſareth to the eaſt, Mount Carmel to the weſt, and Lebanon to the north.

MAGNUS *Portus*, in *Ancient Geography*, a port of the Belgæ, in Britain, on the Channel. Now thought to be Portſmouth in Hampſhire.—Another *Portus Magnus* of Bætica in Spain; a port to the eaſt of Abdera.

MAGO, the name of ſeveral Carthaginian generals. See CARTHAGE.

MAGO, in *Ancient Geography*, a citadel and town of the Balearis Minor, or Minorca. Now Maon, or Mahon. E. Long. 4. 6. N. Lat. 39. 5.

MAGONTIACUM, MOGONTIACUM, or *Mogontiacus*, truncated afterwards by the poets to Mogontia, Maguntia, and Moguntia: a town of Gallia Belgica. Now *Mentz*, capital of the electorate of that name; ſituated at the confluence of the Rhine and Maine. E. Long. 8° N. Lat. 50°.

MAGOPHONIA (formed from μαγος, "magus," and φωνος, "ſlaughter"), the name of a feaſt among the ancient Perſians, held in memory of the expulſion of the Magians. The Magian Smerdis having uſurped the throne of Perſia, upon the death of Cambyſes, 521 years before Jeſus Chriſt, ſeven of the principal lords of the court conſpired to drive him out of it.—Their deſign was executed with good ſucceſs. Smerdis and his brother, another Magian, called Patizithes, were killed. Upon which the people alſo roſe, and put all the Magi to the ſword, inſomuch that there would not one have eſcaped, had not night come upon them. Darius, ſon of Hyſtaſpes, was then elected king; and, in memory of this maſſacre of the Magi, a feaſt was inſtituted, ſays Herodotus, called *Magophonia*. See MAGI.

MAGPIE. See CORVUS, ORNITHOLOGY *Index*.

MAHIE, the name given by the inhabitants of Otaheite, or George's iſland, to their bread-fruit when made into a kind of ſour paſte, which, in conſequence of having undergone a fermentation, will keep a conſiderable