ENCYCLOPÆDIA BRITANNICA.

NICANDER of COLOPHON, a celebrated grammarian, poet, and phyſician, who lived about the 160th Olympiad, 140 years before Chriſt, in the reign of Attalus king of Pergamus, who overcame the Gallo-Greeks. He lived many years in Etolia, of which country he wrote a hiſtory. He wrote alſo many other works, of which only two are now remaining. The one is entitled *Theriaca*, deſcribing in verſe the accidents attending wounds made by venomous beaſts, with the proper remedies; the other bearing the title of *Alexipharmaca*, wherein he treats poetically of poiſons and their antidotes. This Nicander is not to be confounded with Nicander of Thyatira.

NICANDRA, a genus of plants belonging to the decandria claſs; and in the natural method ranking under the 30th order, *Contortæ*. See BOTANY *Index*.

NICARAGUA, a large river of South America, in a province of the ſame name, whoſe weſtern extremity lies within five miles of the South ſea. It is full of dreadful cataracts, and falls at length into the North ſea.

NICARAGUA, a maritime province of South America, in Mexico, bounded on the north by Honduras, on the eaſt by the North ſea, on the ſouth-eaſt by Coſta Rica, and on the ſouth-weſt by the South ſea; being 400 miles in length from eaſt to weſt, and 120 in breadth from north to ſouth. It is one of the moſt fruitful and agreeable provinces in Mexico, and is well watered with lakes and rivers. The air is wholeſome and temperate; and the country produces plenty of ſugar, cochineal, and fine chocolate. One of the lakes is 200 miles in circumference, has an iſland in the middle, and, as ſome ſay, has a tide. Leon de Nicaragua is the capital town.

NICARIA, an iſland of the Archipelago, between Samos and Tine, about 50 miles in circumference. A chain of high mountains runs through the middle, covered with wood, and ſupplies the country with ſprings. The inhabitants are very poor, and of the Greek communion; however, they have a little wheat, and a good deal of barley, figs, honey, and wax.

NICASTRO, an epiſcopal town of Italy, in the kingdom of Naples, and in the Farther Calabria; 16 miles ſouth of Coſenza. E. Long. 16. 21. N. Lat. 39. 15.

NICE, an ancient, handſome, and conſiderable town on the confines of France and Italy, and capital of a county of the ſame name, with a ſtrong citadel, a biſhop's ſee, and a ſenate, which is a kind of a democracy. It has been ſeveral times taken by the French, and laſt of all in 1792, but reſtored after the treaty of Aix-la-Chapelle. It is very agreeably ſituated, four miles from the mouth of the river Var, 83 miles S. by W. of Turin, and 83 E. of Aix. E. Long. 6. 22. N. Lat. 43. 42.

NICE, a county and province in the dominions of the duke of Savoy. The inhabitants ſupply Genoa with a great deal of timber for building ſhips; and carry on a great trade in linen cloth, paper, oil, wine, and honey.—"Although the county of Nice be on this ſide of the mountains, geographers have always conſidered it as a province of Italy, ſince they have given to this beautiful part of Italy the river Var for a weſtern limit, which is alſo the boundary of the county, and flows into the ſea at a league diſtance from the capital. This province is partly covered by the maritime Alps; and is bordered on the eaſt by Piedmont, and the ſtates of Genoa; on the ſouth by the Mediterranean; on the weſt by the Var; and on the north by Dauphiny. Its length is about 20 leagues of the country, which make about 36 Engliſh miles; its breadth is 10 leagues; and its population is about 120,000 ſouls.

Hiſtorical and Picturesque Deſcription of the County of Nice.

"The city of Nice is the capital, and the ſeat of the ſenate, the biſhopric, and government. It has become, within theſe few years, a delightful abode, by the number of ſtrangers who aſſemble there in the winter, either to re-eſtabliſh their health, or to enjoy the mildneſs of the climate, and the beauty of the country, where an unceaſing verdure preſents eternal ſpring.

"The town is ſituated on the ſea ſhore, and is backed by a rock entirely inſulated, on which was formerly a caſtle, much eſteemed for its poſition; but it was deſtroyed in the year 1706 by Marechal Berwick, the garriſon being too thin to defend the extent of the works. There is a diſtinction between the old and the new town; this laſt is regular, the houſes are well built, and the ſtreets are wide. Its poſition is by the ſide of the ſea, and it is terminated, on one ſide, by a charming terrace, which ſerves for a promenade.

"Any perſon may live peaceably in this province, without fear of being troubled on points of faith, provided he conducts himſelf with decorum. The town has three ſuburbs. 1ſt, That of St John, which conducts to Cimier, about three leagues north from Nice, &c. The promenades this way are very delightful, and may be enjoyed in a carriage. 2d, That of the Poudriere. 3d, 3d, That of the *Croix de Marbre*, or Marble Crofs. This fuburb is new; and the Englifh almoft all lodge in it, being very near the town. The houfes are commodious, facing on one fide the great road which leads to France, and on the other a fine garden, with a profpect of the fea. All the houfes are feparate from each other: the company hire them for the feafon, i.e. from October till May. Apartments may be had from 15 to 250 louis. The proprietors commonly furnifh linen, plate, &c. There are alfo in the town very large and commodious houfes; as well as the new road, which is opened from the town to the port, by cutting that part of the rock which inclined toward the fea. The fituation is delightful, and warmeft in winter, being entirely covered from the north wind, and quite open to the fouth.

"The company is brilliant at Nice, and the amufements of the Carnival are, in proportion to the fize of the town, as lively as in any of the great ones in France. There is always an Italian opera, a concert and mafked ball, alternately; and the company play rather high.

"It is impoffible to find a happier climate than Nice, both for fummer and winter. Reaumur's thermometer, in 1781, never fell more than three degrees below the freezing point, and that only for two days; while at Geneva it fell ten: and in the courfe of the winter of 1785 it fell only two degrees; while at Geneva it fell 15. The month of May is rarely fo fine in France as February at Nice. The fummer is not fo hot as might be expected. The thermometer never rifes more than 24 degrees (86° Fahren.) above temperate in the fhade; and there is always an agreeable fea breeze from ten in the morning till funfet, when the land breeze comes on. There are three chains of graduated mountains, the laft of which confound their fummits with the Alps; and to this triple rampart is owing the mild temperature fo fenfibly different from that of the neighbouring parts.

"The cultivation of the ground is as rich as can be defired. There are alternately rows of corn and beans, feparated by vines attached to different fruit-trees, the almond and the fig; fo that the earth being inceffantly cultivated, and covered with trees, olive, orange, cedar, pomegranate, laurel, and myrtle, caufes the conftant appearance of fpring, and forms a fine contraft with the fummits of the Alps, in the back ground, covered with fnow."

NICE, an ancient town of Afia, in Natolia, now called *Ifnic*, with a Greek archbifhop's fee. It is famous for the general council affembled here in 325, which endeavoured to fuppress the doctrines of Arius. It was formerly a large, populous, and well built place, and even now is not inconfiderable. See ISNIC.

NICENE Creed, was compofed and eftablifhed, as a proper fummary of the Chriftian faith, by the council at Nice in 325, againft the Arians.—It is alfo called the *Conftantinopolitan creed*, becaufe it was confirmed, with fome few alterations, by the council of Conftantinople in 381. See CREED.

NICEPHORUS, GREGORAS, a Greek hiftorian, was born about the clofe of the 13th century, and flourifhed in the 14th, under the emperors Andronicus, John Palæologus, and John Cantacuzenus. He was a great favourite of the elder Andronicus, who made him librarian of the church of Conftantinople, and fent him ambaffador to the prince of Servia. He accompanied this emperor in his misfortunes, and affifted at his death; after which he repaired to the court of the younger Andronicus, where he feems to have been well received; and it is certain that, by his influence over the Greeks, that church was prevailed on to refufe entering into any conference with the legates of Pope John XXII. But in the difpute which arofe between Barlaam and Palamos, taking the part of the former, he maintained it zealoufly in the council that was held at Conftantinople in 1351, for which he was caft into prifon, and continued there till the return of John Palæologus, who releafed him; after which he held a difputation with Palamos, in the prefence of that emperor. He compiled a hiftory, which in 11 books contains all that paffed from 1204, when Conftantinople was taken by the French, to the death of Andronicus Palæologus the younger, in 1341.—The beft edition of this work is that of the Louvre, in Greek and Latin, in 1702.

NICEPHORUS, *Califtus*, a Greek hiftorian, who flourifhed in the 14th century under the emperor Andronicus Palæologus the elder, wrote an ecclefiaftical hiftory in 23 books; 18 of which are ftill extant, containing the tranfactions of the church from the birth of Chrift to the death of the emperor Phocas in 610.—We have nothing elfe but the arguments of the other five books, from the commencement of the reign of the emperor Heraclius, to the end of that of Leo the Philofopher, who died in the year 911. Nicephorus dedicated his hiftory to Andronicus Palæologus the elder. It was tranflated into Latin by John Langius; and has gone through feveral editions, the beft of which is that of Paris, in 1630.

NICERON, JOHN FRANCIS, a French philofopher, was born at Paris in 1613. Having finifhed his academical ftudies, with a fuccefs which raifed the greateft hopes of him, he entered into the order of the Minims, and took the habit in 1632; and, as is ufual, he changed the name given him at his baptifm for that of Francis, the name of his paternal uncle, who was alfo a Minim, or Francifcan. The inclination and tafte which he had for mathematics appeared early. He began to apply himfelf to that fcience in his philofophical ftudies, and devoted to it all the time he could fpare from his other employments, after he had completed his ftudies in theology. All the branches of the mathematics, however, did not equally engage his attention; he confined himfelf particularly to optics, and only learned of the reft as much as was neceffary for rendering him perfect in this. There remain ftill, in feveral houfes wherein he dwelt, efpecially at Paris, fome excellent performances, which difcover his fkill in this way, and which make us regret that a longer life did not fuffer him to carry it to that perfection which he defired; fince one cannot help being furprifed that he proceeded fo far as he did, in the midft of thofe occupations and travels by which he was forced from it, during the fhort fpace of time which he lived. He hath himfelf obferved, in the preface to his *Thaumaturgus Opticus*, that he went twice to Rome; and that, on his return home, he was appointed teacher of theology. He was afterwards chofen to accompany Father Francis de la Noue, vicar general of the order, in his vifitation of the convents throughout all France. But the eagernefs of

Niceron.

of his passion for study put him upon making the best of all the moments he had to spare for books; and that wise economy furnished him with as much as satisfied him. Being taken sick at Aix in Provence, he died there Sept. 22. 1646, aged 33. He was an intimate acquaintance of Des Cartes. The following are his principal works: 1. *L'Interpretation des chiffres, ou regles pour bien entendre et expliquer facilement toutes sortes des chiffres simples*, &c. 2. *La perspective curieuse, ou magie artificielle des effets merveilleux de l'optique, catoptrique, et dioptrique*. This is only an essay to the following work: 3. *Thaumaturgus opticus; sive, Admiranda optices, catoptrices, et dioptrices, pars prima*, &c. Two other parts were intended to complete the latter work, but were unfinished at his death.

NICERON, *John Peter*, so much celebrated on account of his Memoirs of Men illustrious in the Republic of Letters, was born at Paris, March 11. 1685. He was of an ancient and noble family, who were in very high repute about 1540. He studied with success in the Mazarine college at Paris, and afterwards at the college Du Plessis. In a short time, resolving to forsake the world, he consulted one of his uncles, who belonged to the order of Barnabite Jesuits. This uncle examined him; and, not diffident of his election, introduced him as a probationer to that society at Paris.—He was received there in 1702, took the habit in 1703, and made his vows in 1704, at the age of 19.

After he had professed himself, he was sent to Montarges, to go through a course of philosophy and theology: thence he went to Loches in Touraine to teach those sciences. He received the priesthood at Poitiers in 1708. As he was not arrived at the age to assume this order, a dispensation, which his uncommon piety had merited, was obtained in his favour. The college of Montarges having recalled him, he was their professor of rhetoric two years, and of philosophy four.—In spite of all these avocations, he was humanely attentive to every call and work of charity, and to the instruction of his fellow creatures, many of whom heard him deliver out fit rules of conduct for them, not only from the pulpits of most of the churches within the province, but even from those of Paris.—In 1716, his superiors invited him to that city, that he might have an opportunity of following, with the more convenience, those studies for which he always had expressed the greatest inclination. He not only understood the ancient but the modern languages; a circumstance of infinite advantage in the composition of those works which he has given to the public, and which he carried on with great assiduity to the time of his death, which happened, after a short illness, July 8. 1738. at the age of 53. His works are, 1. *Le grand Febrifuge*; or, a Dissertation to prove that common water is the best remedy in fevers, and even in the plague, translated from the English of John Hancock minister of St Margaret's, London; in 12mo. This little treatise made its appearance, amongst other pieces relating to this subject, in 1720; and was attended with a success which carried it through three editions; the last came out in 1730, in 2 vols. 12mo, entitled, A Treatise on Common Water; Paris, printed by Cavelier. 2. The Voyages of John Ouvington to Surat, and divers parts of Asia and Africa, containing the history of the revolution in the kingdom of Golconda, and some observations upon silk worms; Paris, 1725, 2 vols. 12mo. 3. The Conversion of England to Christianity, compared with its pretended Reformation, a work translated from the English; Paris 1729, 8vo. 4. The Natural History of the Earth, translated from the English of Mr Woodward, by M. Nogues, doctor in physic; with an answer to the objections of Dr Camerarius; containing also several letters written on the same subject, and a methodical distribution of fossils, translated from the English by Niceron; Paris, 1735, 4to. 5. Memoirs of Men illustrious in the Republic of Letters, with a critical account of their works; Paris, 12mo. The first volume of this great work appeared in 1727; the others were given to the public in succession, as far as the 39th, which appeared in 1738. The 40th volume was published after the death of the author, in 1739.

Nicetas || Nicholls.

NICETAS, David, a Greek historian, a native, as some relate, of Paphlagonia, who lived about the end of the 9th century. He wrote The Life of St Ignatius, patriarch of Constantinople, which was translated into Latin by Frederic Mutius, bishop of Termoli: he composed also several panegyrics in honour of the apostles and other saints, which are inserted in the last continuation of the *Bibliotheca Patrum* by Combesis.

NICETAS, surnamed *Serron*, deacon of the church of Constantinople, cotemporary with Theophylact in the 11th century, and afterwards bishop of Heraclea, wrote a Catena upon the book of Job, compiled from passages of several of the fathers, which was printed at London in folio, 1637. We have also, by the same writer, several *catenæ* upon the Psalms and Canticles, Basil, 1552; together with a Commentary on the poems of Gregory Nazianzen.

NICETAS, *Arhominates*, a Greek historian of the 13th century, called *Coniates*, as being born at Chone, or Colossus, in Phrygia. He was employed in several considerable affairs at the court of Constantinople; and when that city was taken by the French in 1204, he withdrew, with a young girl taken from the enemy, to Nice in Bithynia, where he married his captive, and died in 1206. He wrote a History, or Annals, from the death of Alexius Comnenus in the year 1118, to that of Badouin in 1205; of which work we have a Latin translation by Jerome Wolfius, printed at Basil in 1557; and it has been inserted in the body of the Byzantine Historians, printed in France at the Louvre.

NICHE, in *Architecture*, a hollow sunk into a wall, for the commodious and agreeable placing of a statue. The word comes from the Italian *nechia*, "sea-shell;" in regard the statue is here enclosed in a shell, or perhaps on account of the shell wherewith the tops of some of them are adorned.

NICHOLLS, Dr Frank, physician and anatomist, was born in London in the year 1699. His father was a barrister at law; and both his parents were of good families in Cornwall. After receiving the first rudiments of his education at a private school in the country, where his docility and sweetness of temper endeared him equally to his master and his school fellows, Frank was in a few years removed to Westminster, and from thence to Oxford, where he was admitted a commoner (or sojourner) of Exeter college, under the tuition of Mr John Haviland, on March 4. 1714. There he applied himself diligently to all the usual academical studies, but particularly to natural philosophy and polite literature, Nicholls literature, of which the fruits were moſt conſpicuous in his ſubſequent lectures on phyſiology. After reading a few books on anatomy, in order to perfect himſelf in the nomenclature of the animal parts then adopted, he engaged in diſſections, and then devoted himſelf to the ſtudy of nature, perfectly free and unbiaſſed by the opinions of others.

On his being choſen reader of anatomy in that univerſity, he employed his utmoſt attention to elevate and illuſtrate a ſcience which had there been long depreſſed and neglected; and by quitting the beaten track of former lecturers, and minutely inveſtigating the texture of every bowel, the nature and order of every veſſel, &c. he gained a high and juſt reputation. He did not then reſide at Oxford; but, when he had finiſhed his lectures, uſed to repair to London, the place of his abode, where he had determined to ſettle. He had once an intention of fixing in Cornwall, and for a ſhort time practiſed there with great reputation; but being ſoon tired of the fatigues attendant on that profeſſion in the country, he returned to London, bringing back with him a great inſight, acquired by diligent obſervation, into the nature of the miliary fever, which was attended with the moſt ſalutary effects in his ſubſequent practice at London.

About this time he reſolved to viſit the continent, partly with a view of acquiring the knowledge of men, manners, and languages; but chiefly to acquaint himſelf with the opinions of foreign naturaliſts on his favourite ſtudy. At Paris, by converſing freely with the learned, he ſoon recommended himſelf to their notice and eſteem. Winſlow's was the only good ſyſtem of phyſiology at that time known in France, and Morgagni's and Santorini's of Venice in Italy, which Dr Nicholls likewiſe ſoon after viſited. On his return to England, he repeated his phyſiological lectures in London, which were much frequented, not only by ſtudents from both the univerſities, but alſo by many ſurgeons, apothecaries, and others. Soon after, his new and ſucceſsful treatment of the miliary fever, then very prevalent in the ſouthern parts of England, added much to his reputation. In 1725, at a meeting of the Royal Society, he gave his opinion on the nature of *aneuriſms*, in which he diſſented from Dr Freind in his Hiſtory of Phyſic.

At the beginning of the year 1728, he was choſen a fellow of the Royal Society, to which he afterwards communicated the deſcription of an uncommon diſorder (publiſhed in the Tranſactions), viz. a polypus, reſembling a branch of the pulmonary vein (for which Tulpius has ſtrangely miſtaken it), coughed up by an aſthmatic perſon. He alſo made obſervations (in the ſame volume of the Tranſactions) on a treatiſe, by M. Helvetius of Paris, on the Lungs. Towards the end of the year 1729, he took the degree of doctor of phyſic at Oxford. At his return to London, he underwent an examination by the preſident and cenſors of the College of Phyſicians, previous to his being admitted a candidate, which every practitioner muſt be a year before he can apply to be choſen a fellow. Dr Nicholls was choſen into the college on June 26. 1732; and two years after, being choſen Gulſtonian reader of Pathology, he made the ſtructure of the heart, and the circulation of the blood, the ſubject of his lectures. In 1736, at the requeſt of the preſident, he again read the Gulſtonian lecture; taking for his ſubject thoſe parts of the human body which ſerve for the ſecretion and diſcharge of the urine; and the cauſes, ſymptoms, and cure of the diſeaſes occaſioned by the ſtone. In 1739, he delivered the anniverſary Harveian oration. In 1743, he married Elizabeth, youngeſt daughter of the celebrated Dr Mead, by whom he had five children, two of whom died young. Two ſons and a daughter ſurvived him. In 1748, Dr Nicholls undertook the office of chirurgical lecturer, beginning with a learned and elegant diſſertation on the *Anima Medica*. About this time, on the death of Dr John Cuningham, one of the elects of the college, Dr Abraham Hall was choſen to ſucceed him in preference to our author, who was his ſenior, without any apparent reaſon. With a juſt reſentment, he immediately reſigned the office of chirurgical lecturer, and never after attended the meetings of the fellows, except when buſineſs of the utmoſt importance was in agitation. Nicholls.

In 1751, he took ſome revenge in an anonymous pamphlet, entitled "The petition of the Unborn Babes to the Cenſors of the Royal College of Phyſicians of London;" in which Dr Neſbit (*Pocus*), Dr Maule (*Maulus*), Dr Barrowby (*Barebone*), principally, and Sir William Brown, Sir Edward Hulſe, and the Scots incidentally, are the objects of his ſatire.

In 1753, on the death of Sir Hans Sloane, Bart. in his 94th year, Dr Nicholls was appointed to ſucceed him as one of the king's phyſicians, and held that office till the death of his royal maſter in 1760; when this moſt ſkilful phyſician was ſuperſeded with ſomething like the offer of a penſion, which he rejected with diſdain.

The cauſes, &c. of the uncommon diſorder of which the late king died, viz. a rupture of the right ventricle of the heart, our author explained in a letter to the earl of Macclesfield, preſident of the Royal Society, which was publiſhed in the Philoſophical Tranſactions, vol. l.

In 1772, to a ſecond edition of his treatiſe *De Anima Medica*, he added a diſſertation *De motu cordis et ſanguinis in homine nato et non nato*, inſcribed to his learned friend and coadjutor the late Dr Lawrence.

Tired at length of London, and alſo deſirous of ſuperintending the education of his ſon, he removed to Oxford, where he had ſpent moſt agreeably ſome years in his youth. But when the ſtudy of the law recalled Mr Nicholls to London, he took a houſe at Epſom, where he paſſed the remainder of his life in a literary retirement, not inattentive to natural philoſophy, eſpecially the cultivation of grain, and the improvement of barren ſoils, and contemplating alſo with admiration the internal nature of plants, as taught by Linnæus.

His conſtitution never was robuſt. In his youth, at Oxford, he was with difficulty recovered from a dangerous fever by the ſkill of Doctors Frampton and Frewen; and afterwards at London he had frequently been afflicted with a catarrh, and an inveterate aſthmatic cough, which, returning with great violence at the beginning of the year 1778, deprived the world of this valuable man on January 7th, in the 80th year of his age.

Dr Lawrence, formerly preſident of the college of phyſicians, who gratefully aſcribed all his phyſiological and medical knowledge to his precepts, and who, while he

Nicias || Nicobar.

he lived, loved him as a brother, and revered him as a parent, two years after printed, and gave to his friends, a few copies of an elegant Latin Life of Dr Nicholls (with his head prefixed, a ſtriking likeneſs, engraved by Hall from a model of Goſſet, 1779); from which, through the medium of the Gentleman's Magazine, the above particulars are chiefly extracted.

NICIAS, a celebrated painter of Athens, flouriſhed about 322 years before the Chriſtian era; and was univerſally extolled for the great variety and noble choice of his ſubjects, the force and relievo of his figures, his ſkill in the diſtribution of the lights and ſhades, and his dexterity in repreſenting all ſorts of four-footed animals, beyond any maſter of his time. His moſt celebrated piece was that of Tartarus or Hell, as it is deſcribed by Homer, for which King Ptolemy the ſon of Lagus offered him 60 talents, or 11,250l. which he refuſed, and generouſly preſented it to his own country. He was much eſteemed likewiſe by all his cotemporaries for his excellent talent in ſculpture.

NICKEL, a metallic ſubſtance; for the nature of which, ſee CHEMISTRY *Index*; and for an account of its ores, ſee MINERALOGY *Index*.

NICOBAR ISLANDS, the name of ſeveral iſlands in Aſia, lying at the entrance of the gulf of Bengal. The largeſt of theſe iſlands is about 40 miles long and 15 broad, and the inhabitants are ſaid to be a harmleſs ſort of people, ready to ſupply the ſhips that ſtop there with proviſions. The ſouth end of the great Nicobar is placed in eaſt longitude 94° 23′ 30″; and we collect from Mr Rennel's Memoir, that it is within the 12th degree of north latitude.

Of the northernmoſt iſland, which is called *Carnicobar*, we have, in the ſecond volume of the Aſiatic Reſearches, ſome intereſting information reſpecting both the produce and natural hiſtory of the country, and the manners of its inhabitants. The author of the memoir is Mr G. Hamilton, who, in his account of this iſland, ſays, "It is low, of a round figure, about 40 miles in circumference, and appears at a diſtance as if entirely covered with trees: however, there are ſeveral well cleared and delightful ſpots upon it. The ſoil is a black kind of clay, and marſhy. It produces in great abundance, and with little care, moſt of the tropical fruits, ſuch as pine apples, plantains, papayes, cocoa-nuts, and areca-nuts; alſo excellent yams, and a root called *cachu*. The only four-footed animals upon the iſland are, hogs, dogs, large rats, and an animal of the lizard kind, but large, called by the natives *tolonqui*; theſe frequently carry off fowls and chickens. The only kind of poultry are hens, and thoſe not in great plenty. There are abundance of ſnakes of many different kinds, and the inhabitants frequently die of their bites. The timber upon the iſland is of many ſorts, in great plenty, and ſome of it remarkably large, affording excellent materials for building or repairing ſhips.

"The natives are low in ſtature, but very well made, and ſurpriſingly active and ſtrong; they are copper-coloured, and their features have a caſt of the Malay, quite the reverſe of elegant. The women in particular are extremely ugly. The men cut their hair ſhort, and the women have their heads ſhaved quite bare, and wear no covering but a ſhort petticoat, made of a ſort of ruſh or dry graſs, which reaches half way down the thigh. This graſs is not interwoven, but hangs round the perſon ſomething like the thatching of a houſe. Such of them as have received preſents of cloth petticoats from the ſhips, commonly tie them round immediately under the arms. The men wear nothing but a narrow ſtrip of cloth about the middle, in which they wrap up their privities ſo tight that there hardly is any appearance of them. The ears of both ſexes are pierced when young; and by ſqueezing into the holes large plugs of wood, or hanging heavy weights of ſhells, they contrive to render them wide, and diſagreeable to look at. They are naturally diſpoſed to be good humoured and gay, and are very fond of ſitting at table with Europeans, where they eat every thing that is ſet before them; and they eat moſt enormouſly. They do not care much for wine, but will drink bumpers of *arack* as long as they can ſee. A great part of their time is ſpent in feaſting and dancing. When a feaſt is held at any village, every one that chooſes goes uninvited, for they are utter ſtrangers to ceremony. At thoſe feaſts they eat immenſe quantities of pork, which is their favourite food. Their hogs are remarkably fat, being fed upon the cocoa-nut kernel and ſea water; indeed all their domeſtic animals, fowls, dogs, &c. are fed upon the ſame. They have likewiſe plenty of ſmall ſea fiſh, which they ſtrike very dexterouſly with lances, wading into the ſea about knee deep. They are ſure of killing a very ſmall fiſh at 10 or 12 yards diſtance. They eat the pork almoſt raw, giving it only a haſty grill over a quick fire. They roaſt a fowl, by running a piece of wood through it, by way of ſpit, and holding it over a briſk fire until the feathers are burnt off, when it is ready for eating, in their taſte. They never drink water; only cocoa-nut milk, and a liquor called *ſoura* which oozes from the cocoa-nut tree after cutting off the young ſprouts or flowers. This they ſuffer to ferment before it be uſed, and then it is intoxicating; to which quality they add much by their method of drinking it, by ſucking it ſlowly through a ſmall ſtraw. After eating, the young men and women, who are fancifully dreſſed with leaves, go to dancing, and the old people ſurround them ſmoking tobacco and drinking *ſoura*. The dancers, while performing, ſing ſome of their tunes, which are far from wanting harmony, and to which they keep exact time. Of muſical inſtruments they have only one kind, and that the ſimpleſt. It is a hollow bamboo about two feet and a half long and three inches in diameter, along the outſide of which there is ſtretched from end to end a ſingle ſtring made of the threads of a ſplit cane, and the place under the ſtring is hollowed a little to prevent it from touching. This inſtrument is played upon in the ſame manner as a guitar. It is capable of producing but few notes; the performer, however, makes it ſpeak harmoniouſly, and generally accompanies it with the voice.

"Their houſes are generally built upon the beach, in villages of 15 or 20 houſes each; and each houſe contains a family of 20 perſons and upwards. Theſe habitations are raiſed upon wooden pillars about 10 feet from the ground; they are round, and, having no windows, are like bee-hives, covered with thatch. The entry is through a trap door below, where the family mount by a ladder, which is drawn up at night. This manner of building is intended to ſecure the houſes from being infeſted with ſnakes and rats; and for that purpoſe the pillars are bound round with a ſmooth kind of

leaf,

Nicobar. leaf, which prevents animals from being able to mount; besides which, each pillar has a broad round flat piece of wood near the top of it, the projecting of which effectually prevents the further progress of such vermine as may have passed the leaf. The flooring is made with thin strips of bamboos, laid at such distances from one another as to leave free admission for light and air; and the inside is neatly finished and decorated with fishing lances, nets, &c.

"The art of making cloth of any kind is quite unknown to the inhabitants of this island; what they have is got from the ships that come to trade in cocoanuts.

"They purchase a much larger quantity of cloth than is consumed upon their own island. This is intended for the Choury market. Choury is a small island to the southward of theirs, to which a large fleet of their boats sails every year about the month of November, to exchange cloth for canoes; for they cannot make these themselves. This voyage they perform by the help of the sun and stars, for they know nothing of the compass.

"In their disposition there are two remarkable qualities. One is their entire neglect of compliment and ceremony; and the other, their aversion to dishonesty. A Carnicobarian travelling to a distant village, upon business or amusement, passes through many towns in his way without speaking to any one; if he is hungry or tired, he goes into the nearest house, and helps himself to what he wants, and sits till he is rested, without taking the smallest notice of any of the family unless he has business or news to communicate. Theft or robbery is so very rare amongst them, that a man going out of his house never takes away his ladder or shuts his door, but leaves it open for any body to enter that pleases without the least apprehension of having any thing stolen from him.

"Their intercourse with strangers is so frequent, that they have acquired in general the barbarous Portuguese so common over India; their own language has a sound quite different from most others, their words being pronounced with a kind of stop, or catch in the throat, at every syllable.

"They have no notion of a God, but they believe firmly in the devil, and worship him from fear. In every village there is a high pole erected with long strings of ground rattans hanging from it, which, it is said, has the virtue to keep him at a distance. When they see any signs of an approaching storm, they imagine that the devil intends them a visit, upon which many superstitious ceremonies are performed. The people of every village march round their own boundaries, and fix up at different distances small sticks split at the top, into which split they put a piece of cocoa-nut, a whisp of tobacco, and the leaf of a certain plant; whether this is meant as a peace offering to the devil or a scarecrow to frighten him away, does not appear.

"When a man dies, all his live stock, cloth, hatchets, fishing lances, and in short every moveable thing he possessed, is buried with him, and his death is mourned by the whole village. In one view this is an excellent custom, seeing it prevents all disputes about the property of the deceased amongst his relations. His wife must conform to custom by having a joint cut off from one of her fingers; and if she refuses this, she must submit to have a deep notch cut in one of the pillars of her house. Nicobar.

"I was once present at the funeral of an old woman. When we went into the house which had belonged to the deceased, we found it full of her female relations; some of them were employed in wrapping up the corpse in leaves and cloth, and others tearing to pieces all the cloth which had belonged to her. In another house hard by, the men of the village with a great many others from the neighbouring towns, were sitting drinking *soura* and smoking tobacco. In the mean time two stout young fellows were busy digging a grave in the sand near the house. When the women had done with the corpse, they set up a most hideous howl, upon which the people began to assemble round the grave, and four men went up into the house to bring down the body; in doing this they were much interrupted by a young man, son to the deceased, who endeavoured with all his might to prevent them; but finding it in vain, he clung round the body, and was carried to the grave along with it: there, after a violent struggle, he was turned away and conducted back to the house. The corpse being now put into the grave, and the lashings which bound the legs and arms cut, all the live stock which had been the property of the deceased, consisting of about half a dozen hogs, and as many fowls, was killed, and flung in above it; a man then approached with a bunch of leaves stuck upon the end of a pole, which he swept two or three times gently along the corpse, and then the grave was filled up. During the ceremony, the women continued to make the most horrible vocal concert imaginable: the men said nothing. A few days afterwards, a kind of monument was erected over the grave, with a pole upon it, to which long strips of cloth of different colours were hung.

"Polygamy is not known among them; and their punishment of adultery is not less severe than effectual. They cut, from the man's offending member, a piece of the foreskin proportioned to the frequent commission or enormity of the crime.

"There seems to subsist among them a perfect equality. A few persons, from their age, have a little more respect paid to them; but there is no appearance of authority one over another. Their society seems bound rather by mutual obligations continually conferred and received; the simplest and best of all ties."

It is our wish to take all opportunities of laying before our readers every authentic fact which can throw light upon the philosophy of the human mind. In this narrative of Mr Hamilton's respecting the natives of Carnicobar, there is however one circumstance at which we stumble. It is known to the learned, that the philosophers of Greece and Rome, as well as the magi of Persia, admitted two self-existent beings, a good and an evil (see POLYTHEISM); but we never before read of any people who had no notion of a God, and yet firmly believed in the devil. We could give instances of men worshipping the evil principle from fear, and neglecting the worship of the benevolent principle from a persuasion that he would do them all the good in his power without being bribed by sacrifices

Nicodemus.

crifices and oblations; but this is the only inftance of which we have ever heard, of a people, under the influence of religion, who had *no notion of a God!* As good is at leaft as apparent in the world as evil, it appears to us fo very unnatural to admit an *evil* and deny a *good* principle, that we cannot help thinking that Mr Hamilton, from his ignorance of the language of Carnicobar, (which he acknowledges to be different from moft others), has not a perfect acquaintance with the religious creed of the natives: and that they believe in a good as well as in an evil principle, though they worfhip only the latter, from a perfuafion, that to adore the former could be of no advantage either to him or to themfelves.

Naucowry or Soury, and Comerty, two other of the Nicobar iflands, are faid to be the beft peopled, containing not lefs than 800 inhabitants. Between thefe iflands there is a fafe and fpacious harbour. On the north point of Nancowry, within the harbour, the Danes have long retained a fmall fettlement, protected by a fergeant and a few foldiers and flaves.

NICODEMUS, a difciple of Jefus Chrift, a Jew by nation, and by fect a Pharifee (John iii. 1. &c.) The Scripture calls him a ruler of the Jews, and our Saviour gives him the name of a mafter of Ifrael. When our Saviour began to manifeft himfelf by his miracles at Jerufalem, at the firft paffover that he celebrated there after his baptifm, Nicodemus made no doubt but that he was the Meffiah, and came to him by night, that he might learn of him the way of falvation. Jefus told him, that no one could fee the kingdom of heaven except he fhould be born again. Nicodemus taking this in the literal fenfe, made anfwer, " How can a man that is old be born again? Can he enter the fecond time into his mother's womb?" To which Jefus replied, " If a man be not born of water and of the fpirit, he cannot enter into the kingdom of God. That which is born of the flefh is flefh, and that which is born of the fpirit is fpirit." Nicodemus afks him, " How can thefe things be?" Jefus anfwered, " Are you a mafter of Ifrael, and are you ignorant of thefe things? We tell you what we know, and you receive not our teftimony. If you believe not common things, and which may be called earthly, how will you believe me if I fpeak to you of heavenly things? Nobody has afcended into heaven but the Son of God, who came down from thence. And juft as Mofes lifted up the brazen ferpent in the wildernefs, fo muft the Son of Man be lifted up on high. For God fo loved the world that he has given his only Son, fo that no man who believes in him fhall perifh, but fhall have eternal life."

After this converfation Nicodemus became a difciple of Jefus Chrift; and there is no doubt to be made, but he came to hear him as often as our Saviour came to Jerufalem. It happened on a time, that the priefts and Pharifees had fent officers to feize Jefus (John vii. 45. &c.), who returning to them, made their report, that never man fpoke as he did; to which the Pharifees replied, " Are you alfo of his difciples? Is there any one of the elders or Pharifees that have believed in him?" Then Nicodemus thought himfelf obliged to make anfwer, faying, " Does the law permit us to condemn any one before he is heard?" To which they replied, " Are you alfo a Galilean? Read the Scriptures, and you will find that never any prophet came out of Galilee." After this the council was difmiffed. At laft Nicodemus declared himfelf openly a difciple of Jefus Chrift (*Id.* xix. 39, 40.), when he came with Jofeph of Arimathea to pay the laft duties to the body of Chrift, which they took down from the crofs, embalmed, and laid in a fepulchre.

Nicolaitans || Nicomedes.

We are told, that Nicodemus received baptifm from the difciples of Chrift; but it is not mentioned whether before or after the paffion of our Lord. It is added, that the Jews being informed of this, depofed him from his dignity of fenator, excommunicated him, and drove him from Jerufalem: but that Gamaliel, who was his coufin-german, took him to his country houfe, and maintained him there till his death, when he had him buried honourably near St Stephen. There is ftill extant an apocryphal gofpel under the name of Nicodemus, which in fome manufcripts bears the title of the *Acts of Pilate*.

NICOLAITANS, in church hiftory, Chriftian heretics, who affumed this name from Nicholas of Antioch; who, being a Gentile by birth, firft embraced Judaifm and then Chriftianity; when his zeal and devotion recommended him to the church of Jerufalem, by whom he was chofen one of the firft deacons. Many of the primitive writers believe that Nicholas was rather the occafion than the author of the infamous practices of thofe who affumed his name, who were exprefsly condemned by the Spirit of God himfelf, Rev. ii. 6. And indeed their opinions and actions were highly extravagant and criminal. They allowed a community of wives, and made no diftinction between ordinary meats and thofe offered to idols. According to Eufebius, they fubfifted but a fhort time; but Tertullian fays, that they only changed their name, and that their herefies paffed into the fect of the Cainites.

NICOLAS, St, an ifland of the Atlantic ocean, and one of the moft confiderable of thofe of Cape Verd, lying between Santa Lucia and St Jago. It is of a triangular figure, and about 75 miles in length. The land is ftony, mountainous, and barren; their are a great many goats in a valley inhabited by the Portuguefe. W. Long. 33. 35. N. Lat. 17. 0.

NICOLO, St, the moft confiderable, ftrongeft, and beft peopled of the ifles of Tremeti in the gulf of Venice, to the eaft of St Domino, and to the fouth of Capparata. It has a harbour defended by feveral towers; and a fortrefs, in which is an abbey, with a very handfome church. E. Long. 15. 37. N. Lat. 42. 10.

NICOMEDES, the name of feveral kings of the ancient Bithynia. See BITHYNIA.

NICOMEDES I. had no fooner taken poffeffion of his father's throne, before Chrift 270, than, according to the cuftom which has in all ages been too prevalent among the defpots of the eaft, he caufed two of his brothers to be put to death. The youngeft, Zibœas, having faved himfelf by timely flight, feized on the coaft of Bithynia, which was then known by the names of *Thracia Thyniccia*, and *Thracia Afiatica*, and there maintained a long war with his brother. Nicomedes being informed that Antiochus Soter, king of Syria, was making great preparations to attack him at the fame time, called in the Gauls to his affiftance; and on this occafion that people firft paffed into Afia.— Nicomedes having with their affiftance repulfed Antiochus, Nicomedes. chus, overcome his brother, and acquired the poffeffion of all his father's dominions, beftowed upon them that part of Afia Minor which from them was called *Gallo-Græcia*, and Gallatia. Having now no enemies to contend with, he applied himfelf to the enlarging and adorning of the city of Aftacus, which he called after his own name *Nicomedia*. He had two wives, and by one of them he was perfuaded to leave his kingdom to her fon, in preference to his elder brothers; but when or how he died is not certainly known.

NICOMEDES II. the grandfon of the former, began his reign like him, by facrificing his brothers to his jealoufy, after having waded to the throne in the blood of Prufias his father. He affumed the name of *Epiphanes*, or "the Illuftrious," though he performed nothing worthy of this title, or even of notice, during the whole time of his long reign. He was fucceeded by his fon——

NICOMEDES III. furnamed, by antiphrafis, *Philopater*, becaufe he had murdered his father to get poffeffion of his crown. This monarch having entered into alliance with Mithridates the Great king of Pontus, invaded Paphlagonia; and having feized on that country, he attempted likewife to make himfelf mafter of Cappadocia. This country, however, was at that time fubject to his powerful ally; who thereupon marching into Bithynia at the head of an army, drove Nicomedes from the throne, and raifed his brother Socrates to it in his room. The dethroned prince had recourfe to the Romans, who expelled the ufurper, and reftored him to his hereditary dominions. For this favour they preffed him, and at length prevailed upon him, contrary to his own inclination, and the opinion of his friends, to make inroads into the territories of Mithridates, with whom Rome wanted a fubject of difpute. The king of Pontus bore for fome time the devaftations committed by Nicomedes with great patience, that he might not feem to be the aggreffor; but at laft he routed his army on the banks of the Amnius, drove him a fecond time from his dominions, and obliged him to feek for fhelter in Paphlagonia, where he led a private life till the time of Sylla, who replaced him on the throne. He was fucceeded by his fon——

NICOMEDES IV. who performed nothing which the many writers who flourifhed in his time have thought worth tranfmitting to pofterity. As he died without iffue male, he left his kingdom by his laft will to the Romans, who reduced it to the form of a province. Salluft, difagreeing with the ancients, tells us, that Nicomedes left a fon named *Mufa* or *Myfa*; and introduces Mithridates as complaining of the Romans to Arfaces king of Parthia, for feizing on the kingdom of Bithynia, and excluding the fon of a prince who had on all occafions fhown himfelf a fteady friend to their republic. But this Mufa was the daughter and not the fon of Nicomedes, as we are told in exprefs terms by Suetonius, Velleius Paterculus, and Appian. All we know of her is, that upon the death of her father fhe claimed the kingdom of Bithynia for her fon, as the next male heir to the crown, but without fuccefs; no motives of juftice being of fuch weight with the ambitious Romans as to make them part with a kingdom.

NICOMEDIA, in *Ancient Geography*, a metropolis of Bithynia, built by Nicomedes the grandfather of Prufias. It is fituated on a point of the Sinus Aftacenus, (Pliny); furnamed the *Beautiful*, (Athenæus): the largeft city of Bithynia, (Paufanias), who fays it was formerly called *Aftacus*; though Pliny diftinguifhes Aftacum and Nicomedia as different cities. Nicomedia was very famous, not only under its own kings, but under the Romans: it was the royal refidence of Dioclefian, and of Conftantine while Conftantinople was building, if we may credit Nicephorus. It is ftill called *Nicomedia*, at the bottom of a bay of the Propontis in the Hither Afia. E. Long. 30. 0. N. Lat. 41. 20. It is a place of confequence; carries on a trade in filk, cotton, glafs, and earthen ware, and is the fee of a Greek archbifhop. Nicomedia || Nicon.

NICOMEDUS, a geometrician, famous on account of the invention of the curve called *conchoid*, which is equally ufeful in refolving the two problems of doubling the cube and trifecting the angle. It appears that he lived foon after Eratofthenes, for he rallied that philofopher on the mechanifm of his mefolabe. Geminus, who lived in the fecond century before Jefus Chrift, has written on the conchoid, though Nicomedus was always efteemed the inventor of it. Thofe who place him four or five centuries after Jefus Chrift muft be ignorant of thefe facts, by which we are enabled to afcertain pretty nearly the time in which he lived.

NICON, a native of Ruffia, was born in 1613, in a village of the government of Nifhnei Novogorod, of fuch obfcure parents, that their names and ftation are not tranfmitted to pofterity. He received at the baptifmal font the name of *Nikita*, which afterwards, when he became monk, he changed to *Nicon*, the appellation by which he is more generally known. He was educated in the convent of St Macarius, under the care of a monk. From the courfe of his ftudies, which were almoft folely directed to the Holy Scriptures, and the exhortations of his preceptor, he imbibed at a very early period the ftrongeft attachment to a monaftic life; and was only prevented from following the bent of his mind by the perfuafions and authority of his father. In conformity, however, to the wifhes of his family, though contrary to his own inclination, he entered into matrimony; and, as that ftate precluded him from being admitted into a convent, he was ordained a fecular prieft. With his wife he continued ten years, partly in the country and partly at Mofcow, officiating as a parifh prieft. The lofs of three children, however, gave him a total difguft to the world; in confequence of which, his wife was perfuaded to take the veil, and he became a monk; his retreat was in an ifland of the White fea, and a kind of ecclefiaftical eftablifhment was formed, as remarkable for the aufterities of its rules as the fituation was for its folitude. There were about 12 monks, but they all lived in different cells. Such a fyftem, combined with the moft gloomy ideas, occafioned fo much cloiftered pride as tarnifhed his character, when he was afterwards called up to fulfil the duties of a public and exalted ftation. Our limits do not permit us to be minute in our account of his life, we muft therefore be contented with barely reciting general facts. Within lefs than the fpace of five years, Nicon was fucceffively successively created archimandrite, or abbot of the Novospatskoi convent, archbishop of Novogorod, and patriarch of Russia. That he was worthy of these rapid promotions, few will doubt who are acquainted with his character; for he was possessed of very extraordinary qualities, such as even his enemies allow and admire. His courage was undaunted, his morals irreproachable, his charity extensive and exalted, his learning deep and comprehensive, and his eloquence commanding. When archbishop, he obtained the respect of the inhabitants by his unwearied assiduity in the discharge of his trust; and conciliated their affections by acts of unbounded charity: Nor was he less conspicuous in the discharge of the office of patriarch, to which dignity he was appointed in 1652, in the 39th year of his age.

Nor was he only distinguished in his own profession, for he shone even as a statesman. At length, however, he fell a victim to popular discontents; which misfortune, though he was far from deserving it, was certainly the effect of imprudence. He abdicated the office of patriarch, which would otherwise have been taken from him, in July 1658, and bore his reverse of fortune with heroic magnanimity: he returned to a cell, and commenced his former austerities. His innocence, however, could not protect him from further malice: his enemies obtained him to be formally deposed in 1666. This degradation was followed by imprisonment, which was for some time very rigorous, because he, conscious of his own innocence, refused to accept pardon for crimes of which he was not guilty. In 1676, however, he was removed to the convent of St Cyril, and enjoyed perfect liberty.

Nicon survived his deposition 15 years. In 1681, he requested and obtained permission to return to the convent of Jerusalem, that he might end his days in that favourite spot; but he expired upon the road near Yaroslaf, in the 66th year of his age. His remains were transported to that convent, and buried with all the ceremonies used at the interment of patriarchs.

NICOPOLI, a town of Turkey in Europe, and in Bulgaria, famous for being the place where the first battle was fought between the Turks and Christians in 1396; and where the latter were defeated with the loss of 20,000 men. E. Long. 25. 33. N. Lat. 43. 46.

NICOSIA, the capital of the island of Cyprus, where a Turkish bashaw resides. It is delightfully situated between the mountains of Olympus and a chain of others, and was formerly well fortified by the Venetians; but the works are now in ruins. It is about 31 miles in circumference; and there are plantations of olives, almonds, lemons, oranges, mulberries, and cypress trees, interspersed among the houses, which give the town a delightful appearance. The church of Sancta Sophia is an old Gothic structure, which the Turks have turned into a mosque, and destroyed the ornaments. It is 100 miles west of Tripoli, and 160 south-west of Aleppo. E. Long. 34. 45. N. Lat. 34. 54.

NICOT, John, lord of Villemain, and master of requests of the French king's household, was born at Nismes, and was sent ambassador to Portugal in 1559; whence he brought the plant which, from his name, was called *Nicotiana*, but is now more generally known by the name of *Tobacco*. He died at Paris in 1603. He wrote a French and Latin dictionary in folio; a treatise on navigation; and other works.

NICOTIANA, tobacco, a genus of plants belonging to the pentandria class, and in the natural method ranking under the 28th order, *Luridæ*. See Botany *Index*.—There are seven species, of which the most remarkable is the *tabacum*, or common tobacco plant. This was first discovered in America by the Spaniards about the year 1560, and by them imported into Europe. It had been used by the inhabitants of America long before; and was called by those of the islands *yoli*, and *pætun* by the inhabitants of the continent. It was sent into Spain from Tabaco, a province of Yucatan, where it was first discovered, and from whence it takes its common name. Sir Walter Raleigh is generally said to have been the first that introduced it into England about the year 1585, and who taught his countrymen how to smoke it. Dr Cotton Mather, however, (in his Christian Philosopher) says, that in the above year one Mr Lane carried over some of it from Virginia, which was the first time it had ever been seen in Europe. Tobacco is commonly used among the oriental nations, though it is uncertain by whom it was introduced among them. Considerable quantities of it are cultivated in the Levant, on the coasts of Greece and the Archipelago, in Italy, and in the island of Malta.

There are two varieties of that species of nicotiana which is cultivated for common use, and which are distinguished by the names of *Oronokoe*, and *sweet-scented tobacco*. They differ from each other only in the figure of their leaves; those of the former being longer and narrower than the latter. They are tall herbaceous plants, growing erect with fine foliage, and rising with a strong stem from six to nine feet high. The stalk near the root is upward of an inch diameter, and surrounded with a kind of hairy or velvet clammy substance, of a yellowish green colour. The leaves are rather of a deeper green, and grow alternately at the distance of two or three inches from each other. They are oblong, of a spear-shaped oval, and simple; the largest about 20 inches long, but decreasing in size as they ascend, till they come to be only 10 inches long, and about half as broad. The face of the leaves is much corrugated, like those of spinage when fear ripe. Before they come to maturity, when they are about five or six inches long, the leaves are generally of a full green, and rather smooth; but as they increase in size, they become rougher, and acquire a yellowish cast. The stem and branches are terminated by large bunches of flowers collected into clusters, of a delicate red; the edges, when full blown, inclining to a pale purple. They continue in succession till the end of the summer; when they are succeeded by seeds of a brown colour, and kidney-shaped. These are very small, each capsule containing about 1000; and the whole produce of a single plant is reckoned at about 350,000. The seeds ripen in the month of September.

Mr Carver informs us, that the Oronokoe, or, as it is called, the *long Virginian tobacco*, is the kind best suited for bearing the rigour of a northern climate, the strength as well as the scent of the leaves being greater than that of the other. The *sweet-scented* sort flourishes most in a sandy soil, and in a warm climate, where

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where it greatly exceeds the former in the celerity of its growth; and is likewise, as its name intimates, much more mild and pleasant.

Culture.—Tobacco thrives best in a warm, kindly, rich soil, that is not subject to be overrun by weeds. In Virginia, the soil in which it thrives best is warm, light, and inclining to be sandy; and therefore, if the plant is to be cultivated in Britain, it ought to be planted in a soil as nearly of the same kind as possible. Other kinds of soil might probably be brought to suit it, by a mixture of proper manure; but we must remember, that whatever manure is made use of, must be thoroughly incorporated with the soil. The best situation for a tobacco plantation is the southern declivity of a hill, rather gradual than abrupt, or a spot that is sheltered from the north winds: but at the same time it is necessary that the plants enjoy a free air; for without that they will not prosper.

As tobacco is an annual plant, those who intend to cultivate it ought to be as careful as possible in the choice of the seeds; in which, however, with all their care, they may be sometimes deceived. The seeds are to be sown about the middle of April, or rather sooner in a forward season, in a bed prepared for this purpose of such soil as has been already described, mixed with some warm rich manure. In a cold spring, hot beds are most eligible for this purpose, and gardeners imagine that they are always necessary: but Mr Carver tells us, that he is convinced, when the weather is not very severe, the tobacco seeds may be raised without doors; and for this purpose gives us the following directions.

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"Having sown the seed in the manner above directed, on the least apprehension of a frost after the plants appear, it will be necessary to spread mats over the beds, a little elevated from the ground by poles laid across, that they may not be crushed. These, however, must be removed in the morning, soon after the sun appears, that they may receive as much benefit as possible from its warmth and from the air. In this manner proceed till the leaves have attained about two inches in length and one in breadth; which they will do in about a month after they are sown, or near the middle of May, when the frosts are usually at an end. One invariable rule for their being able to bear removal is, when the fourth leaf is sprouted, and the fifth just appears. Then take the opportunity of the first rains or gentle showers to transplant them into such a soil and situation as before described; which must be done in the following manner.—The land must be ploughed, or dug up with spades, and made as mellow and light as possible. When the plants are to be placed, raise with the hoe small hillocks at the distance of two feet or a little more from each other, taking care that no hard sods or lumps are in it; and then just indent the middle of each, without drilling holes, as for some other plants.

"When your ground is thus prepared, dig in a gentle manner from their native bed such plants as have attained the proper growth for transplanting above-mentioned; and drop, as you pass, one on every hillock. Insert a plant gently into each centre, pressing the soil around gently with your fingers; and taking the greatest care, during the operation, that you do not break off any of the leaves, which are at this time exquisitely tender. If the weather proves dry after they are thus transplanted, they must be watered with soft water, in the same manner as is usually done to coleworts, or plants of a similar kind. But though you now seem to have a sufficient quantity of plants for the space you intend to cultivate, it is yet necessary that you continue to attend to your bed of seedlings, that you may have enough to supply any deficiencies which through accident may arise. From this time great care must be taken to keep the ground soft and free from weeds, by often stirring with your hoe the mould round the roots; and to prune off the dead leaves that sometimes are found near the bottom of the stalk.

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"The difference of this climate from that in which I have been accustomed to observe the progress of this plant, will not permit me to direct with certainty the time which is most proper to take off the top of it, to prevent it from running to seed. This knowledge can only be acquired by experience. When it has risen to the height of more than two feet, it commonly begins to put forth the branches on which the flowers and seeds are produced; but as this expansion, if suffered to take place, would drain the nutriment from the leaves, which are the most valuable part, and thereby lessen their size and efficacy, it becomes needful at this stage to nip off the extremity of the stalk to prevent its growing higher. In some other climates, the top is commonly cut off when the plant has 15 leaves; but if the tobacco is intended to be a little stronger than usual, this is done when it has only 13; and sometimes, when it is designed to be remarkably powerful, 11 or 12 are only allowed to expand. On the contrary, if the planter is desirous of having his crop very mild, he suffers it to put forth 18 or 20: but in this calculation, the three or four lower leaves next the ground, which do not grow so large and fine as the others, are not to be reckoned.

"This operation, denominated *topping* the tobacco, is much better performed by the finger and thumb than with any instrument; because the grasp of the fingers closes the pores of the plant; whereas, when it is done by instruments, the juices are in some degree exhausted. Care must also be taken to nip off the sprouts that will be continually springing up at the junction of the leaves with the stalks. This is termed *succouring*, or *suckering*, the tobacco; and ought to be repeated as often as occasion requires.

"As it is impossible to ascertain the due time for topping the plant, so it is equally impossible, without experiment, to ascertain the time it will take to ripen in this country. The apparent signs of its maturity are these: The leaves, as they approach a state of ripeness, become more corrugated or rough; and when fully ripe, appear mottled with yellowish spots on the raised parts; whilst the cavities retain their usual green colour. They are at this time also thicker than they have been before; and are covered with a downy velvet, like that formerly mentioned, on the stalks. If heavy rains happen at this critical period, they will wash off this excrescent substance, and thereby damage the plants. In this case, if the frosty nights are not begun, it is proper to let them stand a few days longer; when, if the weather be moderate, they will recover this substance again. But if a frost unexpectedly happens during-

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ring the night, they muſt be carefully examined in the morning, before the ſun has any influence upon them; and thoſe which are found to be covered with froſty particles, whether thoroughly ripe or not, muſt be cut up; for though they may not all appear to be arrived at a ſtate of maturity, yet they cannot be far from it, and will differ but little in goodneſs from thoſe that are perfectly ſo."

Tobacco is ſubject to be deſtroyed by a worm; and without proper care to exterminate this enemy, a whole field of plants may ſoon be loſt. This animal is of the horned ſpecies, and appears to be peculiar to the tobacco plant; ſo that in many parts of America it is diſtinguiſhed by the name of the *tobacco worm.* In what manner it is firſt produced, or how propagated, is unknown: but it is not diſcernible till the plants have attained about half their height; and then appears to be nearly as large as a gnat. Soon after this it lengthens into a worm; and by degrees increaſes in magnitude to the bigneſs of a man's finger. In ſhape it is regular from its head to its tail, without any diminution at either extremity. It is indented or ribbed round at equal diſtances, nearly a quarter of an inch from each other; and having at every one of theſe diviſions a pair of feet or claws, by which it faſtens itſelf to the plant. Its mouth, like that of the caterpillar, is placed under the fore part of the head. On the top of the head, between the eyes, grows a horn about half an inch long, and greatly reſembling a thorn; the extreme part of which is of a brown colour, a firm texture, and the extremity ſharp pointed. It is eaſily cruſhed; being only, to appearance, a collection of green juice encloſed in a membranaceous covering, without the internal parts of an animated being. The colour of its ſkin is in general green, interſperſed with ſeveral ſpots of a yellowiſh white; and the whole covered with a ſhort hair ſcarçely to be diſcerned. Theſe worms are found the moſt predominant during the latter end of July and the beginning of Auguſt; at which time the plants muſt be particularly attended to, and every leaf carefully ſearched. As ſoon as a wound is diſcovered, and it will not be long before it is perceptible, care muſt be taken to deſtroy the cauſe of it, which will be found near it, and from its unſubſtantial texture may eaſily be cruſhed: but the beſt method is to pull it away by the horn, and then cruſh it.

When the tobacco is fit for being gathered, as will appear from an attention to the foregoing directions, on the firſt morning that promiſes a fair day, before the ſun is riſen, take an axe or a long knife, and holding the ſtalk near the top with one hand, ſever it from its root with the other, as low as poſſible. Lay it gently on the ground, taking care not to break off the leaves, and there let it remain expoſed to the rays of the ſun throughout the day, or until the leaves, according to the American expreſſion, are entirely *wilted:* that is, till they become limber, and will bend any way without breaking. But if the weather ſhould prove rainy without any intervals of ſunſhine, and the plants appear to be fully ripe, they muſt be houſed immediately. This muſt be done, however, with great care, that the leaves, which are in this ſtate very brittle, may not be broken. They are next to be placed under proper ſhelter, either in a barn or covered hovel, where they cannot be affected by rain or too much air, thinly ſcattered on the floor; and if the ſun does not appear for ſeveral days, they muſt be left to wilt in that manner; but in this caſe the quality of the tobacco will not be quite ſo good.

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When the leaves have acquired the above-mentioned flexibility, the plants muſt be laid in heaps, or rather in one heap if the quantity is not too great, and in about 24 hours they will be found to ſweat. But during this time, when they have lain for a little while, and begin to ferment, it will be neceſſary to turn them; bringing thoſe which are in the middle to the ſurface, and placing thoſe which are at the ſurface in the middle. The longer they lie in this ſituation, the darker coloured is the tobacco; and this is termed *ſweating* the tobacco. After they have lain in this manner for three or four days, (for a longer continuance might make the plants turn mouldy), they may be faſtened together in pairs with cords or wooden pegs, near the bottom of the ſtalk, and hung acroſs a pole, with the leaves ſuſpended in the ſame covered place, a proper interval being left between each pair. In about a month the leaves will be thoroughly dried, and of a proper temperature to be taken down. This ſtate may be aſcertained by their appearing of the ſame colour with thoſe imported from America. But this can be done only in wet weather.—The tobacco is exceedingly apt to attract the humidity of the atmoſphere, which gives it a pliability that is abſolutely neceſſary for its preſervation; for if the plants are removed in a very dry ſeaſon, the external parts of the leaves will crumble into duſt, and a conſiderable waſte will enſue.

Cure. As ſoon as the plants are taken down, they muſt again be laid in a heap, and preſſed with heavy logs of wood for about a week; but this climate may poſſibly require a longer time. While they remain in this ſtate, it will be neceſſary to introduce your hand frequently into the heap, to diſcover whether the heat be not too intenſe; for in large quantities this will ſometimes be the caſe, and conſiderable damage will be occaſioned by it. When they are found to heat too much, that is, when the heat exceeds a moderate glowing warmth, part of the weight by which they are preſſed muſt be taken away; and the cauſe being removed, the effect will ceaſe. This is called the *ſecond* or *laſt ſweating;* and, when completed, which it generally will be about the time juſt mentioned, the leaves muſt be ſtripped from the ſtalks for uſe. Many omit this laſt ſweating; but Mr Carver thinks that it takes away any remaining harſhneſs, and renders the tobacco more mellow. The ſtrength of the ſtalk alſo is diffuſed by it through the leaves, and the whole maſs becomes equally meliorated.—When the leaves are ſtripped from the ſtalks, they are to be tied up in bunches or *hands*, and kept in a cellar or other damp place; though if not handled in dry weather but only during a rainy ſeaſon, it is of little conſequence in what part of the houſe or barn they are laid up. At this period the tobacco is thoroughly cured, and as proper for manufacturing as that imported from the colonies.

Our author adviſes the tobacco planter, in his firſt trials, not to be too avaricious, but to top his plants before they have gained their utmoſt height: leaving only about the middle quantity of leaves directed before to give it a tolerable degree of ſtrength. For though

this,

Nicotiana this, if exceſſive, might be abated during the cure by an increaſe of ſweating, or be remedied the next ſeaſon by ſuffering more leaves to grow, it can never be added; and, without a certain degree of ſtrength, the tobacco will always be taſteleſs and of little value. On the contrary, though it be ever ſo much weakened by ſweating, and thereby rendered mild, yet it will never loſe the aromatic flavour, which accompanied that ſtrength, and which greatly adds to its value. A ſquare yard of land, he tells us, will rear about 500 plants, and allow proper ſpace for their nurture till they are fit for tranſplanting.

The following extract, which is copied from a manuſcript of Dr Barham (A), for directing the raiſing, cultivating, and curing tobacco in Jamaica, is perhaps worthy of the attention of thoſe who wiſh to be further acquainted with this ſubject.

"Let the ground or woodland wherein you intend planting tobacco be well burned, as the greater the quantity of wood aſhes the better. The ſpot you intend raiſing your plants on muſt be well ſtrewed with aſhes, laid ſmooth and light: then blow the ſeed from the palm of your hand gently on the bed, and cover it over with palm or plantain leaves.

"When your plants are about four inches high, draw them and plant them out about three feet aſunder; and when they become as high as your knee, cut or pluck off the top; and if there are more than 12 leaves on the plant, take off the overplus, and leave the reſt entire.

"The plant ſhould now be daily attended to, in order to deſtroy the caterpillars that are liable to infeſt it; as alſo to take off every ſprout or ſucker that puts out at the joints, in order to throw the whole vegetable nouriſhment into the large leaves.

"When the edges and points of the leaves begin to turn a little yellow, cut down the ſtalks about ten o'clock in the morning, taking the opportunity of a fine day, and be careful the dew is fully off the plant, and do not continue this work after two in the afternoon. As faſt as it is cut let it be carried into your tobacco houſe, which muſt be ſo cloſe as to ſhut out all air, (on this much depends), and hung up on lines tied acroſs, for the purpoſe of drying.

"When the ſtalks begin to turn browniſh, take them off the lines, and put them in a large binn, and lay on them heavy weights for 12 days; then take them out, and ſtrip off the leaves, and put them again into the binn, and let them be well preſſed, and ſo as no air gains admiſſion for a month. Take them out; tie them in bundles about 60 leaves in each, which are called *monocoes*; and are ready for ſale. But obſerve to let them always be kept cloſe till you have occaſion to diſpoſe of them.

"Let your curing houſe be well built, and very cloſe and warm; if a boarded building, it will not be amiſs, in a wet ſituation, to cover the whole outſide with thatch and plantain traſh, to keep off the damps; for by this care you preſerve the fine volatile oil in the leaves. Obſerve, no ſmoke is to be made uſe of or admitted into your curing houſe." Nicotiana, Nictitating membrane.

For an account of the medical effects of tobacco. See MATERIA MEDICA *Index*.

The moſt common uſes of this plant, are either as a ſternutatory when taken by way of ſnuff, as a maſticatory by chewing it in the mouth, or as effluvia by ſmoking it; and when taken in moderation, it is not an unhealthful amuſement. Before pipes were invented, it was uſually ſmoked in ſegars, and they are ſtill in uſe among ſome of the ſouthern nations. The method of preparing theſe is at once ſimple and expeditious. A leaf of tobacco being formed into a ſmall twiſted roll, ſomewhat larger than the ſtem of a pipe, and about eight inches long, the ſmoke is conveyed through the winding folds which prevent it from expanding, as through a tube; ſo that one end of it being lighted, and the other applied to the mouth, it is in this form uſed without much inconvenience. But, in proceſs of time, pipes being invented, they were found more commodious vehicles for the ſmoke, and are now in general uſe.

Among all the productions of foreign climes introduced into theſe kingdoms, ſcarce any has been held in higher eſtimation by perſons of every rank than tobacco. In the countries of which it is a native, it is conſidered by the Indians as the moſt valuable offering that can be made to the beings they worſhip. They uſe it in all their civil and religious ceremonies. When once the ſpiral wreaths of its ſmoke aſcend from the feathered pipe of peace, the compact that has been juſt made is conſidered as ſacred and inviolable. Likewiſe, when they addreſs their great Father, or his guardian ſpirits, reſiding, as they believe, in every extraordinary production of nature, they make liberal offerings to them of this valuable plant, not doubting but that they are thus ſecured of protection.

Tobacco is made up into rolls by the inhabitants of the interior parts of America, by means of a machine called a *tobacco wheel*. With this machine they ſpin the leaves after they are cured, into a twiſt of any ſize they think fit; and having folded it into rolls of about 20 pounds each, they lay it by for uſe. In this ſtate it will keep for ſeveral years, and be continually improving, as it always grows milder. The Illinois uſually form it into carrots; which is done by laying a number of leaves, when cured, on each other after the ribs have been taken out, and rolling them round with packthread, till they become cemented together. Theſe rolls commonly meaſure about 18 or 20 inches in length, and nine round in the middle part.

Tobacco forms a very conſiderable article in commerce; for an account of which ſee the articles GLASGOW and VIRGINIA.

NICTITATING MEMBRANE, a thin membrane chiefly found in the bird and fiſh kind, which covers the eyes of theſe animals, ſheltering them from the duſt or too much light; yet is ſo thin and pellucid, that they can ſee pretty well through it.

NIDDUI,

(A) This gentleman was cotemporary with Sir Hans Sloane. He was a man of great probity, an able phyſician, and a ſkilful naturaliſt. He collected and arranged a number of the plants of Jamaica, which he preſented to Dr Sloane, and made ſeveral communications to the Royal Society.

NIDDUI, in the Jewiſh cuſtoms, is uſed to ſignify "ſeparated or excommunicated." This, according to ſome, was to be underſtood of the leſſer ſort of excommunication in uſe among the Hebrews. He that had incurred it was to withdraw himſelf from his relations, at leaſt to the diſtance of four cubits: it commonly continued a month. If it was not taken off in that time, it might be prolonged for 60 or even 90 days: but if, within this term, the excommunicated perſon did not give ſatisfaction, he fell into the *cherem*, which was a ſecond ſort of excommunication; and thence into the third ſort, called *ſhammata* or *ſhematta*, the moſt terrible of all. But Selden has proved that there were only two kinds of excommunication, *viz.* the greater and leſs; and that theſe three terms were uſed indifferently.

NIDUS, among naturaliſts, ſignifies a neſt or proper repoſitory for the eggs of birds, inſects, &c. where the young of theſe animals are hatched and nurſed.

NIDIFICATION, a term generally applied to the formation of a bird's neſt, and its hatching or bringing forth its young. See ORNITHOLOGY.

NIECE, a brother's or ſiſter's daughter, which in the civil law is reckoned the third degree of conſanguinity.

NIEMEN, a large river of Poland, which riſes in Lithuania, where it paſſes by Bielica, Grodno, and Konno: it afterwards runs through part of Samogitia and Ducal Pruſſia, where it falls into the lake called the *Curiſch-haff*, by ſeveral mouths, of which the moſt northern is called the *Ruſs*, being the name of a town it paſſes by.

NIENBURGH, a rich and ſtrong town of Germany, in the duchy of Brunſwic-Lunenburg, with a ſtrong caſtle. It carries on a conſiderable trade in corn and wool, and is ſeated in a fertile ſoil on the river Weſer. E. Long. 9. 26. N. Lat. 52. 44.

NIEPER, or DNIEPER, a large river of Europe, and one of the moſt conſiderable of the North, formerly called the Boriſthenes. Its ſource is in the middle of Muſcovy, running weſt by Smolenſko, as far as Orſa; and then turns ſouth, paſſing by Mohilow, Bohaczo, Kiow, Czyrkaſſy, the fortreſs of Kudak, Deſſau, and Oczakow, falling into the Black ſea; as alſo in its courſe it divides Little Tartary from Budziac Tartary.

NIESS, a mountain in the environs of Berne in Switzerland. It is the laſt mountain in a high calcareous chain of hills, of which the Stockhorn, the Neuneren, and the Ganteriſh, have been illuſtrated by the botanical labours of the celebrated Haller. Nieſs ſtands on the borders of the lake Thun, and ſeparates the valley of Frutingen from that of Simme. It is very intereſting to the curious traveller, on account of the fine view from its top; and to naturaliſts, becauſe it joins the Alps. Towards its foot, beds of ſlate have been diſcovered; it is of calcareous ſtone higher up; and near its top is found a ſpecies of puddingſtone, filled with ſmall fragments of broken petrifactions.

NIESTER, a large river of Poland, which has its ſource in the lake Nieſter, in the palatinate of Lemburg, where it paſſes by Halicz. Then it ſeparates Podolia and Oczakow Tartary from Moldavia and Budziac Tartary; and falls into the Black ſea at Belgorod, between the mouths of the Nieper and the Danube.

NIGELLA, FENNEL-FLOWER, or *Devil in a Buſh*, a genus of plants, belonging to the pentandria claſs. See BOTANY *Index*.

NIGER, C. PESCENNIUS JUSTUS, a celebrated governor in Syria, well known by his valour in the Roman armies while in a private ſtation. At the death of Pertinax he was declared emperor of Rome; and his claims to that elevated ſtation were ſupported by a ſound underſtanding, prudence of mind, moderation, courage, and virtue. He propoſed to imitate the actions of the venerable Antoninus, of Trajan, of Titus, and M. Aurelius. He was remarkable for his fondneſs of ancient diſcipline. He never ſuffered his ſoldiers to drink wine, but obliged them when thirſty to uſe water and vinegar. He forbade the uſe of ſilver or gold utenſils in his camp. All the bakers and cooks were driven away, and the ſoldiers were ordered to live during the expedition they undertook merely upon biſcuits. In his puniſhments Niger was inexorable: he condemned ten of his ſoldiers to be beheaded in the preſence of the army becauſe they had ſtolen and eaten a fowl. The ſentence was heard with groans. The army interfered; and when Niger conſented to diminiſh the puniſhment, for fear of kindling rebellion, he yet ordered the criminals to make each a reſtoration of ten fowls to the perſon whoſe property they had ſtolen. They were beſides ordered not to light a fire the reſt of the campaign, but to live upon cold aliments and to drink nothing but water. Such great qualifications in a general ſeemed to promiſe the reſtoration of ancient diſcipline in the Roman armies; but the death of Niger fruſtrated every hope of reform. Severus, who had alſo been inveſted with the imperial purple, marched againſt him: ſome battles were fought, and Niger was at laſt defeated, A. D. 195. His head was cut off and fixed to a long ſpear, and carried in triumph through the ſtreets of Rome. He reigned about a year.

NIGER, a large river in Africa, of which many erroneous opinions have been entertained. According to Herodotus, Pliny, Ptolemy, and many of the ancients, this river runs from weſt to eaſt, an opinion which was long forgotten, and in more modern times it was believed to flow from eaſt to weſt; but from the recent diſcoveries of the indefatigable Mr Park, who himſelf ſaw this majeſtic river, the opinion of the ancients is now fully eſtabliſhed, that its courſe is from weſt to eaſt. The ſource of the Niger is ſuppoſed to be in that mountainous region in weſtern Africa, which gives origin to the rivers Gambia and Senegal, which diſcharge their waters into the Weſtern ocean, while the Niger riſing from the oppoſite ſide of the mountains, takes an eaſterly direction. See AFRICA, p. 264. and 272. The Niger is called *Joliba* by the natives.

NIGHT, that part of the natural day during which the ſun is underneath the horizon; or that ſpace wherein it is duſky.

Night was originally divided by the Hebrews and other eaſtern nations into three parts or watches. The Romans, and after them the Jews, divided the night into four parts or watches; the firſt of which began at ſunſet, and laſted till nine at night, according to our way of reckoning; the ſecond laſted till mid-

night;

Night ‖ Night-Watching.

night; the third till three in the morning; and the fourth ended at sunrise. The ancient Gauls and Germans divided their time not by days but by nights; and the people of Iceland and the Arabs do the same at this day. The like is observed of the Anglo-Saxons.—The length and shortness of night or of darkness is according to the season of the year and position of the place; and the causes of this variety are now well known. See ASTRONOMY, &c.

NIGHT, in scripture language, is used for the times of heathenish ignorance and profaneness (Rom. xiii. 12.); for adversity and affliction (If. xxi. 12.); and, lastly, for death (John ix. 4.).

NIGHT-Angling, a method of catching large and shy fish in the night-time. Trout, and many other of the better sorts of fish, are naturally shy and fearful; they therefore prey in the night as the securest time.—The method of taking them on this plan is as follows: The tackle must be strong, and need not be so fine as for day fishing, when every thing is seen; the hook must be baited with a large earth worm, or a black snail, and thrown out into the river; there must be no lead to the line, so that the bait may not sink, but be kept drawling along, upon or near the surface. Whatever trout is near the place will be brought thither by the motion of the water, and will seize the worm or snail. The angler will be alarmed by the noise which the fish makes in rising, and must give him line, and time to swallow the hook; then a slight touch secures him. The best and largest trouts are found to bite thus in the night; and they rise mostly in the still and clear deeps, not in the swift and shallow currents. Sometimes, though there are fish about the place, they will not rise at the bait: in this case the angler must put on some lead to his line, and sink it to the bottom.

NIGHT-Mare, or *Incubus*. See MEDICINE, N° 329.

NIGHT-Walkers. See MEDICINE, N° 329, and NOCTAMBULI.

NIGHT-Walkers, in *Law*, are such persons as sleep by day and walk by night, being oftentimes pilferers or disturbers of the public peace. Constables are authorized by the common law to arrest night-walkers and suspicious persons, &c. Watchmen may also arrest night-walkers, and hold them until the morning: and it is said, that a private person may arrest any suspicious night-walker, and detain him till he give a good account of himself. One may be bound to the good behaviour for being a night-walker; and common night-walkers, or haunters of bawdy-houses, are to be indicted before justices of peace, &c. But it is not held lawful for a constable, &c. to take up any woman as a night-walker on bare suspicion only of being of ill fame, unless she be guilty of a breach of the peace, or some unlawful act, and ought to be found misdoing.

NIGHTINGALE, a species of motacilla. See ORNITHOLOGY *Index*.

NIGHTSHADE. See SOLANUM, BOTANY *Index*.

Deadly NIGHTSHADE. See ATROPA, BOTANY *Index*.—The berries of this plant are of a malignant poisonous nature; and, being of a sweet taste, have frequently proved destructive to children. It is said, that a large glass of warm vinegar, taken as soon as possible after eating the berries, will prevent their bad effects.

NIGHT-Watching, a practice of very remote antiquity, which belongs to the oldest regulations of police. So early as the time of Solomon we find mention made of it, and likewise in the Psalms of David †. Sentinels were stationed in different places in Athens and other cities of Greece, and they were kept to their duty by the visitations of the *Thesmothetæ*. There were also *triumviri nocturni* in the city of Rome, as appears from the commentaries of Heubach on the police of the Romans. It appears, however, that the design of these institutions was rather the prevention of fires, than the guarding against alarms or dangers by night, although attention was likewise paid to these in process of time. The apprehension of fires was the pretext of Augustus, when he wished to strengthen the night-watch for suppressing nocturnal commotions.

† *Song of Solomon*, chap. iii. ver. 3. *Psal.* cxxvii. 1.

It does not appear that calling out the hours became an established practice before the erection of city gates, and probably had its rise in Germany; yet it would have been attended with advantages in ancient Rome, where there were no public clocks, nor any thing in private houses to indicate the hours. The periods for soldiers to mount guard were determined by water-clocks; at the end of each hour they blew a horn, and by means of this signal each individual might ascertain the hour of the night. It seems evident, however, that these regulations were only attended to in time of war.

In the city of Paris, night-watching was established, as at Rome, in the very commencement of its monarchy; and De la Mare quotes the ordinances of Clothaire II. upon this subject, in the year 595. The citizens at first kept watch in rotation; but this practice was afterwards set aside, and, by the payment of a certain sum of money, a permanent watch was established. In the opinion of the learned and indefatigable Beckmann, the establishment of single watchmen, to call out the hours through the streets, is peculiar to Germany, and only copied by surrounding nations in more modern times. The elector, John George, in 1588, appointed watchmen at Berlin; and Mabillon describes it as a practice peculiar to that country. Horns are made use of by watchmen in some places, and rattles in others, the former being most proper for villages, and the latter for cities.

The Chinese, so early as the ninth century, had watchmen posted on their towers, who announced the hours both by day and night, by striking forcibly on a suspended board, which in that country is said to be in use to the present period; and at Petersburgh, in Russia, the watchmen employ a suspended plate of iron for a similar purpose. In this manner also Christians are assembled together in the Levant, for the purpose of attending divine service; and monks were thus awakened in monasteries at the most early periods, to attend to the proper hours of prayer.

We find mention made of steeple-watchmen in Germany in the 14th century. In the year 1563, a church-steeple was erected in Leisnig, and an apartment built in it for a permanent watchman, who was obliged to proclaim the hours every time the clock struck. Permanent watchmen were kept in many of the steeples at Ulm in the 15th century. The same thing was practised at Frankfort on the Mayne, at Oettingen, and many other places; and Montaigne was astonished at finding a man on the steeple of Constance, who kept watch

watch upon it continually, and who on no pretext whatever was permitted to come down. *Beckmann's Hist. of Inventions*, iii. 425.

NIGIDIUS Figulus, Publius, one of the most learned men of ancient Rome, flourished at the same time with Cicero. He wrote on various subjects; but his pieces appeared so refined and difficult that they were not regarded. He assisted Cicero, with great prudence, in defeating Catiline's conspiracy, and did him many services in the time of his adversity. He adhered to Pompey in opposition to Cæsar; which occasioned his exile, he dying in banishment. Cicero, who had always entertained the highest esteem for him, wrote a beautiful consolatory letter to him (the 13th of lib. iv. *ad Familiares*).

NIGRINA, a genus of plants belonging to the pentandria class. See Botany *Index*.

NIGRINE, an ore of titanium. See Mineralogy *Index*.

NIGRITIA. See Negroland.

NIGUA. See Chegoe.

NILE, a large and celebrated river of Africa, to which the country of Egypt owes its fertility; and the exploring the sources of which has, from the remotest ages, been accounted an impracticable undertaking. This problem has been solved by James Bruce, Esq. of Kinnaird, in Scotland; who spent several years at the court of Abyssinia, and by the favour of the emperor and great people of the country was enabled to accomplish the arduous task.

In the account of his travels, this gentleman has been at particular pains to show, that none of those who undertook this task ever succeeded in it but himself. The inquiry concerning its springs, he says, began either before history or tradition, and is by some supposed to be the origin of hieroglyphics. Though Egypt was the country which received the greatest benefit from this river, it was not there that the inquiries concerning its inundation began: it being probable that every thing relative to the extent and periodical time of that inundation would be accurately settled (which could not be done but by a long series of observations) before any person would venture to build houses within its reach.

The philosophers of Meroe, in our author's opinion, were the first who undertook to make a number of observations sufficient to determine these points; their country being so situated, that they could perceive every thing relative to the increase or decrease of the river without any danger from its overflowing. Being much addicted to astronomy, it could not long escape them, that the heliacal rising of the dog-star was a signal for Egypt to prepare for the inundation; without which it was vain to expect any crop. The connection of this celestial sign with the annual rising of the river would undoubtedly soon become a matter of curiosity; and as this could not easily be discovered, it was natural for an ignorant and superstitious people to ascribe the whole to the action of the dog-star as a deity. Still, however, by those who were more enlightened, the phenomenon would be ascribed to natural causes; and a great step towards the discovery of these, undoubtedly was that of the sources of the river itself. In the early ages, when travelling into foreign countries was impracticable by private persons, the inquiry into the sources of the Nile became an object to the greatest monarchs. Sesostris is said to have preferred the honour of discovering them almost to all the victories he obtained. Alexander the Great is well known to have had a great curiosity to discover these fountains. On his arrival at the temple of Jupiter Ammon, he is said to have made inquiry concerning the fountains of the Nile, even before he asked about his own descent from Jupiter. The priests are said to have given him proper directions for finding them: and Alexander took the most ready means of accomplishing his purpose, by employing natives of Ethiopia to make the search. These discoverers, in the opinion of Mr Bruce, missed their aim, by reason of the turn which the Nile takes to the east in the latitude of 9° where it begins to surround the kingdom of Gojam; but which they might imagine to be only a winding of the river soon to be compensated by an equal turn to the west. "They therefore (says he) continued their journey south till near the line, and never saw it more; as they could have no possible notion it had turned back behind them, and that they had left it as far north as latitude 9°. They reported then to Alexander, what was truth, that they had ascended the Nile, as far south as latitude 9°; where it unexpectedly took its course to the east, and was seen no more. The river was not known, nor to be heard of near the line, or farther southward, nor was it diminished in size, nor had it given any symptom that they were near its source; they had found the Nile *calentem* (warm), while they expected its rise among melting snows.

Mr Bruce is of opinion that this turn of the Nile to the eastward was the occasion of Alexander's extravagant mistake, in supposing that he had discovered the fountains of the Nile when he was near the source of the Indus; and which he wrote to his mother, though he afterwards caused it to be erased from his books.

Ptolemy Philadelphus succeeded Alexander in his attempts to discover the source of the Nile; but he likewise proving unsuccessful, the task was next undertaken by Ptolemy Euergetes, the most powerful of the Greek princes who sat on the throne of Egypt. "In this (says Mr Bruce) he had probably succeeded, had he not mistaken the river itself. He supposed the Siris, now the Tacazze, to be the Nile; and ascending in the direction of its stream, he came to Axum, the capital of Sire and of Ethiopia. But the story he tells of the snow which he found knee-deep on the mountains of Samen, makes me question whether he ever crossed the Siris, or was himself an ocular witness of what he says he observed there."

Cæsar had the same curiosity with other conquerors to visit the springs of the Nile, though his situation did not allow him to make any attempt for that purpose. Nero, however, was more active. He sent two centurions into Ethiopia, with orders to explore the unknown fountains of this river; but they returned without having accomplished their errand. They reported, that, after having gone a long way, they came to a king of Ethiopia, who furnished them with necessaries, and recommendations to some other kingdoms adjacent; passing which, they came to immense lakes, of which nobody knew the end, nor could they ever hope to find it. Their story, however, is by Mr Bruce supposed to be a

fiction;

Nile. fiction; as the Nile forms no lakes throughout its course, excepting that of Tzana or Dembea, the limits of which are easily perceived.

No other attempt was made by the ancients to discover the sources of this celebrated river; and the matter was looked upon to be an impossibility, insomuch that *caput Nili quærere* became a proverb, denoting the impossibility of any undertaking. The first who, in more modern ages, made any attempt of this kind, was a monk sent into Abyssinia in the year 522, by Nonnosus, ambassador from the emperor Justin. This monk is called *Cosmas the Hermit*, and likewise *Indoplaustes*, from his supposed travels into India. He proceeded as far as the city of Axum, but did not visit that part of the country where the head of the Nile lies; nor, in Mr Bruce's opinion, would it have been practicable for him to do so. The discovery, however, is said to have been made at last by Peter Paez the missionary. But the truth of this account is denied by Mr Bruce, for the following reasons: 1. "No relation of this kind (says he) was to be found in three copies of Peter Paez's history, to which I had access when in Italy, on my return home. One of these copies I saw at Milan; and, by the interest of friends, had an opportunity of perusing it at my leisure. The other two were at Bologna and Rome. I ran through them rapidly; attending only to the place where the description ought to have been, and where I did not find it: but having copied the first and last page of the Milan manuscript, and comparing them with the two last mentioned, I found that all the three were, word for word, the same, and none of them contained one syllable of the discovery of the source. 2. Alphonso Mendez came into Abyssinia about a year after Paez's death. New and desirable as that discovery must have been to himself, to the pope, king of Spain, and all his great patrons in Portugal and Italy; though he wrote the history of the country, and of the particulars concerning the mission in great detail and with good judgement, yet he never mentions this journey of Peter Paez, though it probably must have been conveyed to Rome and Portugal after his inspection and under his authority. 3. Balthazar Tellez, a learned Jesuit, has wrote two volumes in folio, with great candour and impartiality, considering the spirit of those times; and he declares his work to be compiled from those of Alphonso Mendez the patriarch, from the two volumes of Peter Paez, as well as from the regular reports made by the individuals of the company in some places, and by the provincial letters in others; to all which he had complete access, as also to the annual reports of Peter Paez, among the rest from 1598 to 1622; yet Tellez makes no mention of such a discovery, though he is very particular as to the merit of each missionary during the long reign of Facilidas, which occupies more than half the two volumes."

The first, and indeed the only account of the fountains of the Nile, published before that of Mr Bruce, was Kircher's; who says that he took it from the writings of Peter Paez. The time when the discovery is said to have been made was the 21st of April 1618; at which season the rains are begun, and therefore very unwholesome; so that the Abyssinian armies are not without extreme necessity in the field; between September and February at farthest is the time they are abroad from the capital and in action.

"The river (says Kircher) at this day, by the Ethiopians, is called *Abavy*; it rises in the kingdom of Gojam, in a territory called *Sabala*, whose inhabitants are called *Agows*. The source of the Nile is situated in the west part of Gojam, in the highest part of a valley, which resembles a great plain on every side surrounded by high mountains. On the 21st of April 1618, being here, together with the king and his army, I ascended the place, and observed every thing with great attention: I discovered first two round fountains each about four palms in diameter, and saw, with the greatest delight, what neither Cyrus the Persian, nor Cambyses, nor Alexander the Great, nor the famous Julius Cæsar, could ever discover. The two openings of these fountains have no issue in the plain on the top of the mountain, but flow from the root of it. The second fountain lies about a stone-cast west from the former: the inhabitants say that this whole mountain is full of water; and add, that the whole plain about the fountain is floating and unsteady, a certain mark that there is water concealed under it; for which reason the water does not overflow at the fountain, but forces itself with great violence out at the foot of the mountain. The inhabitants together with the emperor, who was then present with his army, maintain, that that year it trembled very little on account of the drought; but in other years, that it trembled and overflowed so that it could scarce be approached without danger. The breadth of the circumference may be about the cast of a sling: below the top of this mountain the people live about a league distant from the fountain to the west; and this place is called *Geesh*; and the fountain seems to be about a cannon-shot distant from Geesh; moreover the field where the fountain is, is on all sides difficult of access, except on the north side, where it may be ascended with ease."

On this relation Mr Bruce observes, that there is no such place as *Sabala*; it ought to have been named *Sacala*, signifying the highest ridge of land, where the water falls equally down on both sides, from east and west, or from north and south. So the sharp roofs of our houses, where the water runs down equally on the opposite sides, are called by the same name. Other objections are drawn from the situation of places, and from the number and situation of the fountains themselves, every one of which Mr Bruce found by actual mensuration to be different from Kircher's account. The following, however, he looks upon to be decisive that Paez never was on the spot. He says, "the field in which the fountains of the Nile are, is of very difficult access; the ascent to it being very steep, excepting on the north, where it is plain and easy. Now, if we look at the beginning of this description, we should think it would be the descent, not the ascent, that would be troublesome; for the fountains were placed in a valley, and people rather *descend* into valleys than *ascend* into them; but supposing it was a valley in which there was a field upon which there was a mountain, and on the mountain these fountains; still, I say, that these mountains are nearly inaccessible on the three sides; but that the most difficult of them all is the north, the way we ascend from the plain of Goutto. From the east, by Sacala, the ascent is made from the valley of Litchambara, and from the plain of Assoa to the south you have the almost perpendicular craggy cliff of Geesh, covered with thorny

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thorny bushes, trees, and bamboos, which cover the mouths of the caverns; and on the north you have the mountains of Aformasha, thick set with all sorts of thorny trees and shrubs, especially with the kantuffa: these thickets are, moreover, filled with wild beasts, especially huge, long-haired baboons, which we frequently met walking upright. Through these high and difficult mountains we have only narrow paths, like those of sheep, made by the goats, or the wild beasts we are speaking of, which, after we had walked on them for a long space, landed us frequently at the edge of some valley or precipice, and forced us to go back again to seek a new road. From towards Zeegam to the westward, and from the plain where the river winds so much, is the only easy access to the fountains of the Nile: and they that ascend to them by this way will not even think that approach too easy."

Peter Heiling, a Protestant of Lubec, resided several years in the country of Gojam, and was even governor of it, but he never made any attempt to discover the source of the Nile; dedicating himself entirely to a studious and solitary life. The most extraordinary attempt, however, that ever was made to discover the source of this or any other river, was that of a German nobleman named *Peter Joseph de Roux*, comte de Desreval. He had been in the Danish navy from the year 1721; and, in 1739, was made rear-admiral. That same year he resigned his commission, and began his attempt to discover the source of the Nile in Egypt. To this country he took his wife along with him; and had no sooner reached Cairo, than he quarrelled with a Turkish mob on a point of etiquette; which instantly brought upon them the janizaries and guards of police, to take them into custody. The countess exerted herself in an extraordinary manner; and armed only with a pair of scissars, put all the janizaries to flight, and even wounded several of them; so that her husband was left at liberty to pursue his plan of discovery. To accomplish this, he provided a barge with small cannon, and furnished with all necessary provisions for himself and his wife, who was still to accompany him. Before he set out, however, it was suggested to him, that, supposing government might protect him so far as to allow his barge to pass the confines of Egypt safely, and to the first cataract; supposing also that she was arrived at Ibrim, or Deir, the last garrisons depending on Cairo; yet still some days journey above the garrisons of Deir and Ibrim began the dreadful deserts of Nubia; and farther south, at the great cataract of Jan Adel, the Nile falls 20 feet down a perpendicular rock—so that here his voyage must undoubtedly end. The count, however, flattered himself with being able to obtain such assistance from the garrisons of Ibrim and Deir as would enable him to take the vessel to pieces, and to carry it above the cataract, where it could again be launched into the river. To facilitate this scheme he had even entered into a treaty with some of the barbarians named *Kennousſs*, who reside near the cataract, and employ themselves in gathering sena, which abounds in their country. These promised to assist him in this extraordinary adventure; but, luckily for the count, he suffered himself at last to be persuaded by some Venetian merchants at Cairo not to proceed in person on such a dangerous and unheard-of navigation, but rather to depute Mr Norden, his lieutenant, who was likewise to serve as his draughtsman, to reconnoitre the forts of Ibrim and Deir, as well as the cataract of Jan Adel, and renew his treaty with the Kennouss. This gentleman accordingly embarked upon one of the vessels common on the Nile, but met with a great many difficulties and disasters before he could reach Syene and the first cataract; after which having with still greater difficulty reached Ibrim, instead of meeting with any encouragement for the count to proceed on his voyage, he was robbed of all he had by the governor of the fort, and narrowly escaped with his life; it having been for some time determined by him and his soldiers that Mr Norden should be put to death. By these difficulties the count was so much disheartened, that he determined to make no more attempts on the Nubian side. He now resolved to enter Abyssinia by the island of Masuah. With this view he undertook a voyage round the Cape of Good Hope, in order to reach the Red sea by the straits of Babelmandel: but having begun to use his Spanish commission, and taken two English ships, he was met by Commodore Barnet, who made prizes of all the vessels he had with him, and sent home the count himself passenger in a Portuguese ship to Lisbon.

Thus Mr Bruce considers himself as the first Europopean who reached the sources of this river. He informs us that they are in the country of the Agows, as Kircher had said; so that the latter must either have visited them himself, or have had very good information concerning them. The name of the place through which is the passage to the territory of the Agows, is *Abala;* a plain or rather valley, generally about half a mile, and never exceeding a whole mile, in breadth. The mountains which surround it are at first of an inconsiderable height, covered to the very top with herbage and acacia trees; but as they proceed to the southward they become more rugged and woody.—On the top of these mountains are delightful plains producing excellent pasture. Those to the west join a mountain called *Aformaska*, where, from a direction nearly southeast, they turn south, and enclose the villages and territory of Sacala, which lie at the foot of them; and still lower, that is, more to the westward, is the small village of Geesh, where the fountains of the Nile are situated. Here the mountains are in the form of a crescent; and along these the river takes its course. Those which enclose the east side of the plain run parallel to the former in their whole course, making part of the mountains of Lechtambara, or at least joining with them, and these two, when behind Aformaska, turn to the south, and then to the south-west, taking the same form as they do; only making a greater curve, and enclosing them likewise in the form of a crescent, the extremity of which terminates immediately above a small lake named *Goo-deroo* in the plain of Assoa, below Geesh, and directly at the fountains of the Nile.

Having passed several considerable streams, all of which empty themselves into the Nile, our traveller found himself at last obliged to ascend a very steep and rugged mountain, where no other path was to be found but a very narrow one made by the sheep or goats, and which in some places was broken, and full of holes; in others, he was obstructed with large stones, which seemed to have remained there since the creation. The whole was covered with thick wood; and he was everywhere stopped by the kantuffa, as well as by several other thorny

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thorny plants almoſt as troubleſome as that. Having at laſt, however, reached the top, he had a ſight of the Nile immediately below him; but ſo diminiſhed in ſize, that it now appeared only a brook ſcarcely ſufficient to turn a mill. The village of Geeſh is not within ſight of the fountains of the river, though not more than 600 yards diſtant from them. The country about that place terminates in a cliff of about 300 yards high, which reaches down to the plain of Aiſoa, continuing in the ſame degree of elevation till it meets the Nile again about 17 miles to the ſouthward, after having made the circuit of the provinces of Gojam and Damot. In the middle of this cliff is a vaſt cave running ſtraight northward, with many bye-paths forming a natural labyrinth, of ſufficient bigneſs to contain the inhabitants of the whole village with their cattle. Into this Mr Bruce advanced about 100 yards; but he did not chooſe to go farther, as the candle he carried with him ſeemed ready to go out; and the people aſſured him that there was nothing remarkable to be ſeen at the end. The face of this cliff, fronting the ſouth, affords a very pictureſque view from the plain of Aſſoa below; parts of the houſes appearing at every ſtage through the buſhes and thickets of trees. The mouths of the cavern above mentioned, as well as of ſeveral others which Mr Bruce did not ſee, are hid by almoſt impenetrable fences of the worſt kind of thorn; nor is there any other communication betwixt the upper part and the houſes but by narrow winding ſheep paths, very difficult to be diſcovered; all of them being allowed to be overgrown, as a part of the natural defence of the people. The edge of the cliff is covered with lofty and high trees, which ſeem to form a natural fence to prevent people from falling down; and the beauty of the flowers which the Abyſſinian thorns bear, ſeems to make ſome amends for their bad qualities. From the edge of the cliff of Geeſh, above where the village is ſituated, the ground ſlopes with a deſcent due north, till we come to a triangular marſh upwards of 86 yards broad, and 286 from the edge of the cliff, and from a prieſt's houſe where Bruce reſided. On the eaſt, the ground deſcends with a very gentle ſlope from the large village of Sacala, which gives its name to the territory, and is about ſix miles diſtant from the ſource, though to appearance not above two. About the middle of this marſh, and not quite 40 yards from the foot of the mountain of Geeſh, riſes a circular hillock about three feet from the ſurface of the marſh itſelf, though founded apparently much deeper in it. The diameter of this hillock is not quite 12 feet, and it is ſurrounded by a ſhallow trench which collects the water, and ſends it off to the eaſtward. This is firmly built of ſod brought from the ſides, and kept conſtantly in repair by the Agows, who worſhip the river, and perform their religious ceremonies upon this as an altar. In the midſt of it is a circular hole, in the formation or enlargement of which the work of art is evidently diſcernible. It is always kept clear of graſs and aquatic plants, and the water in it is perfectly pure and limpid, but without any ebullition or motion diſcernible on its ſurface. The mouth is ſome parts of an inch leſs than three feet diameter, and at the time our author firſt viſited it (Nov. 5. 1770), the water ſtood about two inches from the brim, nor did it either increaſe or diminiſh during all the time of his reſidence at Geeſh. On putting down the ſhaft of a lance, he found a very feeble reſiſtance at ſix feet four inches, as if from weak ruſhes and graſs; and, about ſix inches deeper, he found his lance had entered into ſoft earth, but met with no obſtruction from ſtones or gravel: and the ſame was confirmed by uſing a heavy plummet, with a line beſmeared with ſoap.—This is the firſt fountain of the Nile.

Nile.

The ſecond fountain is ſituated at about ten feet diſtant from the former, a little to the weſt of ſouth; and is only 11 inches in diameter, but eight feet three inches deep. The third is about 20 feet SSW from the firſt; the mouth being ſomewhat more than two feet in diameter, and five feet eight inches in depth. Theſe fountains are made uſe of as altars, and from the foot of each iſſues a briſk running rill, which, uniting with the water of the firſt trench, goes off at the eaſt ſide in a ſtream which, our author conjectures, would fill a pipe about two inches diameter. The water of theſe fountains is extremely light and good, and intenſely cold, though expoſed to the ſcorching heat of the ſun, without any ſhelter; there being no trees nearer than the cliff of Geeſh. The longitude of the principal fountain was found by Mr Bruce to be 36° 55′ 30″ E. from Greenwich. The elevation of the ground, according to his account, muſt be very great, as the barometer ſtood only at 22 Engliſh inches. "Neither (ſays he) did it vary ſenſibly from that height any of the following days I ſtaid at Geeſh; and thence I inferred, that at the ſources of the Nile I was then more than two miles above the level of the ſea; a prodigious height, to enjoy a ſky perpetually clear, as alſo a hot ſun never overcaſt for a moment with clouds from riſing to ſetting." In the morning of Nov. 6. the thermometer ſtood at 44°, at noon 96°, and at ſunſet 46°. It was ſenſibly cold at night, and ſtill more ſo about an hour before ſunriſe.

The Nile thus formed by the union of ſtreams from theſe three fountains, runs eaſtward through the marſh for about 30 yards, with very little increaſe of its water, but ſtill diſtinctly viſible, till it is met by the graſſy brink of the land deſcending from Sacala. By this it is turned gradually NE, and then due north; and in the two miles in which it flows in that direction it receives many ſmall ſtreams from ſprings on each ſide; ſo that about this diſtance from the fountains it becomes a ſtream capable of turning a common mill. Our traveller was much taken with the beauty of this ſpot. "The ſmall riſing hills about us (ſays he) were all thick covered with verdure, eſpecially with clover the largeſt and fineſt I ever ſaw; the tops of the heights covered with trees of a prodigious ſize: the ſtream, at the banks of which we were ſitting, was limpid, and pure as the fineſt cryſtal; the ſod covered thick with a kind of buſhy tree, that ſeemed to affect to grow to no height, but, thick with foliage and young branches, rather to aſſiſt the ſurface of the water; whilſt it bore, in prodigious quantities, a beautiful yellow flower, not unlike a ſingle roſe of that colour, but without thorns; and indeed, upon examination, we found that it was not a ſpecies of the roſe, but of the hypericum."

Here Mr Bruce exults greatly in his ſucceſs; as having not only ſeen the fountains of the Nile, but the river itſelf running in a ſmall ſtream; ſo that the ancient ſaying of the poet,

Nec licuit populis parvum te Nile videre,

could not be applied to him. Here he *ſtepped* over it, he ſays, more than 50 times, though he had told us, in the preceding page, that it was *three yards* over. From this ford, however, the Nile turns to the weſtward; and, after

Nile. after running over looſe ſtones occaſionally in that direction about four miles farther, there is a ſmall cataract of about ſix feet in height; after which it leaves the mountainous country, and takes its courſe through the plains of Goutto. Here it flows ſo gently that its motion is ſcarcely to be perceived, but turns and winds in its direction more than any river he ever ſaw; forming more than 20 ſharp angular peninſulas in the ſpace of five miles. Here the ſoil is compoſed of a marſhy clay, quite deſtitute of trees, and very difficult to travel through; and where its ſtream receives no conſiderable addition. Iſſuing out from thence, however, it is joined by ſeveral rivulets which fall from the mountains on each ſide, ſo that it becomes a conſiderable ſtream, with high and broken banks covered with old timber trees for three miles. In its courſe it inclines to the north-eaſt, and winds very much, till it receives firſt a ſmall river named *Diwa*, and then another named *Dee-ohha*, or the river Dee. Turning then ſharply to the eaſt, it falls down another cataract, and about three miles below receives the Jemma, a pure and limpid ſtream, not inferior in ſize to itſelf. Proceeding ſtill to the northward, it receives a number of other ſtreams, and at laſt croſſes the ſouthern part of the lake Tzana or Dembea, preſerving the colour of its ſtream during its paſſage, and iſſuing out at the weſt ſide of it in the territory of Dara.

There is a ford, though very deep and dangerous, at the place where the Nile firſt aſſumes the name of a river, after emerging from the lake Dembea; but the ſtream in other places is exceedingly rapid: the banks in the courſe of a few miles become very high, and are covered with the moſt beautiful and variegated verdure that can be conceived. It is now confined by the mountains of Begemder, till it reaches Alata, where is the third cataract. This, we are informed by Mr Bruce, is the moſt magnificent ſight he ever beheld; but he thinks that the height has rather been exaggerated by the miſſionaries, who make it 50 feet; and after many attempts to meaſure it, he is of opinion that it is nearly 40 feet high. At the time he viſited it, the river had been pretty much ſwelled by rains, and fell in one ſheet of water, without any interval, for the ſpace of half an Engliſh mile in breadth, with ſuch a noiſe as ſtunned and made him giddy for ſome time. The river, for ſome ſpace both above and below the fall, was covered with a thick miſt, owing to the ſmall particles of the water daſhed up into the air by the violence of the ſhock. The river, though ſwelled beyond its uſual ſize, retained its clearneſs, and fell into a natural baſon of rock; the ſtream appearing to run back againſt the foot of the precipice over which it falls with great violence; forming innumerable eddies, waves, and being in exceſſive commotion, as may eaſily be imagined. Jerome Lobo pretends that he was able to reach the foot of the rock, and ſit under the prodigious arch of water ſpouting over it; but Mr Bruce does not heſitate to pronounce this to be an abſolute falſehood. The noiſe of the cataract, which, he ſays, is like the loudeſt thunder, could not but confound and deſtroy his ſenſe of hearing; while the rapid motion of the water before his eyes would dazzle the ſight, make him giddy, and utterly deprive him of all his intellectual powers. "It was a moſt magnificent ſight, (ſays Mr Bruce), that ages, added to the greateſt length of human life, would not deface or eradicate from my memory: it ſtruck me with a kind of ſtupor, and a total oblivion of where I was, and of every other ſublunary concern." Nile.

About half a mile below the cataract, the Nile is confined between two rocks, where it runs in a narrow channel with impetuous velocity and great noiſe. At the village of Alata there is a bridge over it, conſiſting of one arch, and that no more than 25 feet wide. This bridge is ſtrongly fixed into the ſolid rock on both ſides, and ſome part of the parapet ſtill remains. No crocodiles ever come to Alata, nor are any ever ſeen beyond the cataract.

Below this tremendous water-fall the Nile takes a ſouth-eaſt direction, along the weſtern ſide of Begemder and Amhara on the right, encloſing the province of Gojam. It receives a great number of ſtreams from both ſides, and after ſeveral turns takes at laſt a direction almoſt due north, and approaches within 62 miles of its ſource. Notwithſtanding the vaſt increaſe of its waters, however, it is ſtill fordable at ſome ſeaſons of the year; and the Galla croſs it at all times without any difficulty, either by ſwimming, or on goats-ſkins blown up like bladders. It is likewiſe croſſed on ſmall rafts, placed on two ſkins filled with wind: or by twiſting their hands round the tails of the horſes who ſwim over; a method always uſed by the women who follow the Abyſſinian armies, and are obliged to croſs unfordable rivers. In this part of the river crocodiles are met with in great numbers; but the ſuperſtitious people pretend they have charms ſufficiently powerful to defend themſelves againſt their voracity.—The Nile now ſeems to have forced its paſſage through a gap in ſome very high mountains which bound the country of the Gongas, and falls down a cataract of 280 feet high; and immediately below this are two others, both of very conſiderable height. Theſe mountains run a great way to the weſtward, where they are called *Dyre* or *Tegla*, the eaſtern end of them joining the mountains of Kuara, where they have the name of *Fazuclo*. Theſe mountains, our author informs us, are all inhabited by Pagan nations; but the country is leſs known than any other on the African continent. There is plenty of gold waſhed down from the mountains by the torrents in the rainy ſeaſon; which is the fine gold of Sennaar named *Tibbar*.

The Nile, now running cloſe by Sennaar in a direction nearly north and ſouth, makes afterwards a ſharp turn to the eaſt; affording a pleaſant view in the fair ſeaſon, when it is brim-full, and indeed the only ornament of that bare and inhoſpitable country. Leaving Sennaar, it paſſes by many large towns inhabited by Arabs, all of them of a white complexion; then paſſing Gerri, and turning to the north-eaſt, it joins the Tacazze, paſſing, during its courſe through this country, a large and populous town named *Chendi*, probably the Candace of the ancients. Here Mr Bruce ſuppoſes the ancient iſland or peninſula of Meroe to have been ſituated. Having at length received the great river Atbara, the Aſtaboras of the ancients, it turns directly north for about two degrees; then making a very unexpected turn weſt by ſouth for more than two degrees in longitude, and winding very little, it arrives at Korti, the firſt town in Barabra, or kingdom of Dongola. From Korti it runs almoſt ſouthweſt till it paſſes Dongola, called alſo *Beja*, the capital of Barabra; after which it comes

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to Moscho, a considerable town and place of refreshment to the caravans when they were allowed to pass from Egypt to Ethiopia. From thence turning to the north-east it meets with a chain of mountains in about 22° 15′ of N. latitude, where is the seventh cataract named *Jan Adel.* This is likewise very tremendous, though not above half as high as that of Alata. This course is now continued till it falls into the Mediterranean; there being only one other cataract in the whole space, which is much inferior to any of those already described.

This very particular and elaborate account of the sources of the Nile and of the course of the river given by Mr Bruce, hath not escaped criticism. We find him accused by the reviewers, not only of having brought nothing to light that was not previously known to the learned, but even of having revealed nothing which was not previously published in Guthrie's Geographical Grammar. This, however, seems by no means a fair and candid criticism. If the sources of the Nile, as described by Mr Bruce, were known to the author of Guthrie's Grammar, they must likewise have been so to every retailer of geography since the time of the missionaries; which, as the reviewers have particularized that book, would not seem to have been the case. If any thing new was published there previous to the appearance of Mr Bruce's work, it must probably have been derived indirectly from himself; of which clandestine method of proceeding that gentleman has had frequent occasion to complain in other cases. It is alleged, however, that he has given the name of *Nile* to a stream which does not deserve it. This, like all other large rivers, is composed of innumerable branches; to visit the top of every one of which would be indeed an Herculean task. The source of the largest branch therefore, and that which has the longest course, is undoubtedly to be accounted the source of the river; but here it is denied that Mr Bruce had sufficient information. "Of the innumerable streams (say they) that feed the lake of Tzana, there is one that ends in a bog, to which Mr Bruce was conducted by Woldo, a lying guide, who told him it was the source of the Nile. Mr Bruce, in a matter of far less importance, would not have taken Woldo's word; but he is persuaded, that in this case he spoke truth; because the credulous barbarians of the neighbouring district paid something like worship to this brook, which, at the distance of 14 miles from its source, is not 20 feet broad, and nowhere one foot deep. Now it is almost unnecessary to observe, that the natives of that country being, according to Mr Bruce's report, pagans, might be expected to worship the pure and salutary stream, to which, with other extraordinary qualities, their superstition ascribed the power of curing the bite of a mad dog. Had he traced to its source any of the other rivulets which run into the lake Tzana, it is not unlikely that he might have met with similar instances of credulity among the ignorant inhabitants of its banks. Yet this would not prove any one of them in particular to be the head of the Nile. It would be trifling with the patience of our readers to say one word more on the question, whether the Portuguese Jesuits or Mr Bruce discovered what they erroneously call the head of the Nile. Before either they or he had indulged themselves in a vain triumph over the labours of antiquity, they ought to have been sure that they had effected what antiquity was unable to accomplish. Now the river described by the Jesuit Kircher, who collected the information of his brethren, as well as by Mr Bruce, is not the Nile of which the ancients were in quest. This is amply proved by the prince of modern geographers, the incomparable D'Anville (at least till our own Rennel appeared), in a copious memoir published in the 26th volume of the Memoirs of the Academy of Belles Lettres, p. 45.— To this learned dissertation we refer our readers; adding only what seems probable from the writings of Diodorus Siculus and Herodotus, that the ancients had two meanings when they spoke of the head or source of the Nile: First, Literally, the head or source of that great western stream now called the *White River*, which contains a much greater weight of waters, and has a much longer course than the river described by the Jesuits and by Mr Bruce: and, 2dly, Metaphorically, the cause of the Nile's inundation.— This cause they had discovered to be the tropical rains, which fall in the extent of 16 degrees on each side of the line; which made the sacristan of Minerva's temple of Saïs in Egypt tell that inquisitive traveller Herodotus, that the waters of the Nile run in two opposite directions from its source; the one north into Egypt, the other south into Ethiopia; and the reports of all travellers into Africa serve to explain and confirm this observation. The tropical rains, they acknowledge, give rise to the Nile and all its tributary streams which flow northward into the kingdom of Sennaar, as well as to the Zebee, and so many large rivers which flow south into Ethiopia; and then, according to the inclination of the ground, fall into the Indian or Atlantic ocean. Such then, according to the Egyptian priests, is the true and philosophical source of the Nile; a source discovered above 3000 years ago, and not, as Mr Bruce and the Jesuits have supposed, the head of a paltry rivulet, one of the innumerable streams that feed the lake Tzana."

See *Rennel's Map of Herodotus*, p. 441.

On this severe criticism, however, it is obvious to remark, that if the source of the Nile has been discovered so many years ago, there is not the least probability that the finding of it should have been deemed an impossible undertaking, which it most certainly was, by the ancients.—That the finding out the fountains of the river itself was an object of their inquiry, cannot be doubted; and from the accounts given by Mr Bruce, it appears very evident that none of the ancients had equal success with himself; though indeed the Jesuits, as has already been observed, seem to have a right to dispute it with him. From the correspondence of his accounts with that of the Jesuits, it appears certain that the most considerable stream which flows into the lake Tzana takes its rise from the fountains at Geesh already described; and that it is the most considerable plainly appears from its stream being visible through the whole breadth of the lake, which is not the case with any of the rest. The preference given to this stream by the Agows, who worship it, seems also an incontestable proof that they look upon it to be the great river which passes through Ethiopia and Egypt; nor will the argument of the reviewers hold good in *supposing* that other streams are worshipped, unless they could prove that they are so. As little can it be any objection or disparagement

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disparagement to Mr Bruce's labours, that he did not discover the sources of the western branch of the Nile called the *White River*. Had he done so, it might next have been objected that he did not visit the springs of the Tacazze, or any other branch. That the origin of the White river was unknown to the ancients may readily be allowed; but so were the fountains of Geesh, as evidently appears from the erroneous position of the sources of the eastern branch of the Nile laid down by Ptolemy. Our traveller, therefore, certainly has the merit, if not of discovering the sources, at least of confirming the accounts which the Jesuits have given of the sources, of the river called the *Nile;* and of which the White river, whether greater or smaller, seems to be accounted only a branch. The superior veneration paid to the eastern branch of this celebrated river will also appear from the variety of names given to it, as well as from the import of these names; of which Mr Bruce gives the following account.

By the Agows it is named *Gzeir*, *Geesa*, or *Seir;* the first of which terms signifies *a god*. It is likewise named *Ab*, father; and has many other names, all of them implying the most profound veneration. Having descended into Gojam it is named *Abay;* which, according to Mr Bruce, signifies the river that suddenly swells and overflows periodically with rain. By the Gongas on the south side of the mountains Dyre and Tegla, it is called *Dahli*, and by those on the north side *Kowass;* both of which names signify a *watching dog*, the *latrator anubis*, or *dog-star*. In the plain country between Fazuclo and Sennaar it is called *Nile* which signifies *blue;* and the Arabs interpret this name by the word *Azergue;* which name it retains till it reaches Halfaia, where it receives the White river.

Formerly the Nile had the name of *Siris*, both before and after it enters Beja, which the Greeks imagined was given to it on account of its black colour during the inundation; but Mr Bruce assures us that the river has no such colour. He affirms, with great probability, that this name in the country of Beja imports the river of the *dog-star*, on whose vertical appearance this river overflows; "and this idolatrous worship (says he) was probably part of the reason of the question the prophet Jeremiah asks: And what hast thou to do in Egypt to drink the water of Seir, or the water profaned by idolatrous rites?" As for the first, it is only the translation of the word *bahar* applied to the Nile. The inhabitants of the Barabra to this day call it *Bahar el Nil*, or the sea of the Nile, in contradistinction to the Red sea, for which they have no other name than *Bahar el Molech*, or the Salt sea. The junction of the three great rivers, the Nile flowing on the west side of Meroe; the Tacazze, which washes the east side, and joins the Nile at Maggiran in N. Lat. 17°; and the Mareb, which falls into this last something above the junction, gives the name of *Triton* to the Nile.

The name *Ægyptus*, which it has in Homer, and which our author supposes to have been a very ancient name even in Ethiopia, is more difficult to account for. This has been almost universally supposed to be derived from the black colour of the inundation; but Mr Bruce, for the reasons already given, will not admit of this. "Egypt (says he) in the Ethiopic is called *y Gipt*, Agar; and an inhabitant of the country, *Gypt*, for precisely so it is pronounced; which means the country of ditches or canals, drawn from the Nile on both sides at right angles with the river: nothing surely is more obvious than to write *y Gipt*, so pronounced, *Egypt;* and, with its termination *us* or *os*, *Egyptus*. The Nile is also called *Kronides*, Jupiter; and has had several other appellations bestowed upon it by the poets; though these are rather of a transitory nature than to be ranked among the ancient names of the river. By some of the ancient fathers it has been named *Geon;* and by a strange train of miracles they would have it to be one of the rivers of the terrestrial paradise; the same which is said to have encompassed the whole land of Cush or Ethiopia. To effect this, they are obliged to bring the river a great number of miles, not only under the earth, but under the sea also; but such reveries need no refutation.

Under the article EGYPT we have so fully explained the cause of the annual inundation of the Nile, that, with regard to the phenomenon itself, nothing farther seems necessary to be added. We shall therefore only extract from Mr Bruce's work what he has said concerning the mode of natural operation by which the tropical rains are produced; which are now universally allowed to be the cause of the annual overflowing of this and other rivers.

According to this gentleman, the air is so much rarefied by the sun during the time that he remains almost stationary over the tropic of Capricorn, that the other winds loaded with vapours rush in upon the land from the Atlantic ocean on the west, the Indian ocean on the east, and the cold Southern ocean beyond the Cape. Thus a great quantity of vapour is gathered, as it were, into a focus; and as the same causes continue to operate during the progress of the sun northward, a vast train of clouds proceed from south to north, which, Mr Bruce informs us, are sometimes extended much farther than at other times. Thus he tells us, that for two years some white dappled clouds were seen at Gondar, on the 7th of January; the sun being then 34° distant from the zenith, and not the least cloudy speck having been seen for several months before. About the first of March, however, it begins to rain at Gondar, but only for a few minutes at a time, in large drops; the sun being then about 5° distant from the zenith. The rainy season commences with violence at every place when the sun comes directly over it; and before it commences at Gondar, green boughs and leaves appear floating in the Bahar el Abiad, or White river, which, according to the accounts given by the Gallo, our author supposes to take its rise in about 5° north latitude.

The rains therefore precede the sun only about 5°; but they continue and increase after he has passed it. In April all the rivers in the southern parts of Abyssinia begin to swell, and greatly augment the Nile, which is now also farther augmented by the vast quantity of water poured into the lake Tzana. On the first days of May, the sun passes the village of Gerri, which is the limit of the tropical rains; and it is very remarkable, that, though the sun still continues to operate with unabated vigour, all his influence cannot bring the clouds farther northward than this village, the

Nile. the reaſon of which Mr Bruce, with great reaſon, ſuppoſes, to be the want of mountains to the northward. In confirmation of this opinion, he obſerves, that the tropical rains ſtop at the latitude of 14° inſtead of 16° in the weſtern part of the continent. All this time, however, they continue violent in Abyſſinia; and in the beginning of June the rivers are all full, and continue ſo while the ſun remains ſtationary in the tropic of Cancer.

This exceſſive rain, which would ſweep off the whole ſoil of Egypt into the ſea were it to continue without intermiſſion, begins to abate as the ſun turns ſouthward; and on his arrival at the zenith of each place, on his paſſage towards that quarter, they ceaſe entirely: the reaſon of which is no leſs difficult to be diſcovered than that of their coming on when he arrives at the zenith in his paſſage northward. Be the reaſon what it will, however, the fact is certain; and not only ſo, but the time of the rains ceaſing is exact to a ſingle day; inſomuch, that on the 25th of September the Nile is generally found to be at its higheſt at Cairo, and begins to diminiſh every day after. Immediately after the ſun has paſſed the line, he begins the rainy ſeaſon to the ſouthward; the rains conſtantly coming on with violence as he approaches the zenith of each place; but the inundation is now promoted in a different manner, according to the difference of circumſtances in the ſituation of the places. From about 6° S. Lat. a chain of high mountains runs all the way along the middle of the continent towards the Cape of Good Hope, and interſects the ſouthern part of the peninſula nearly in the ſame manner that the Nile does the northern. A ſtrong wind from the ſouth, ſtopping the progreſs of the condenſed vapours, daſhes them againſt the cold ſummits of this ridge of mountains, and forms many rivers, which eſcape in the direction either of eaſt or weſt as the level preſents itſelf. If this is towards the weſt, they fall down the ſides of the mountains into the Atlantic, and if on the eaſt into the Indian ocean.—" The clouds (ſays Mr Bruce), drawn by the violent action of the ſun, are condenſed, then broken, and fall as rain on the top of this high ridge, and ſwell every river; while a wind from the ocean on the eaſt blows like a monſoon up each of theſe ſtreams, in a direction contrary to their current during the whole time of the inundation; and this enables boats to aſcend into the weſtern parts of Sofala, and the interior country, to the mountains where lies the gold. The ſame effect, from the ſame cauſe, is produced on the weſtern ſide towards the Atlantic; the high ridge of mountains being placed between the different countries weſt and eaſt, is at once the ſource of their riches, and of thoſe rivers which conduct to the treaſures, which would be otherwiſe inacceſſible, in the eaſtern parts of the kingdoms of Benin, Congo, and Angola.

" There are three remarkable appearances attending the inundation of the Nile. Every morning in Abyſſinia is clear, and the ſun ſhines. About nine, a ſmall cloud not above four feet broad, appears in the eaſt, whirling violently round as if upon an axis; but arrived near the zenith, it firſt abates its motion, then loſes its form, and extends itſelf greatly, and ſeems to call up vapours from all the oppoſite quarters. Theſe clouds having attained nearly the ſame height, ruſh againſt each other with great violence, and put me always in mind of Eliſha foretelling rain on Mount Carmel. The air, impelled before the heavieſt maſs, or ſwifteſt mover, makes an impreſſion of its form on the collection of clouds oppoſite; and the moment it has taken poſſeſſion of the ſpace made to receive it, the moſt violent thunder poſſible to be conceived inſtantly follows, with rain: after ſome hours the ſky again clears, with a wind at north: and it is always diſagreeably cold when the thermometer is below 63°. Nile.

" The ſecond thing remarkable is the variation of the thermometer. When the ſun is in the ſouthern tropic, 36° diſtant from the zenith of Gondar, it is ſeldom lower than 72°; but it falls to 60°, and 63°, when the ſun is immediately vertical; ſo happily does the approach of rain compenſate the heat of a too ſcorching ſun.

The third is that remarkable ſtop in the extent of the rain northward, when the ſun that has conducted the vapours from the line, and ſhould ſeem now more than ever to be in the poſſeſſion of them, is here over-ruled ſuddenly; till, on his return to Gerri, again it reſumes the abſolute command over the rain, and reconducts it to the line, to furniſh diſtant deluges to the ſouthward."

With regard to the Nile itſelf, it has been ſaid that the quantity of earth brought down by it from Abyſſinia is ſo great, that the whole land of Egypt is produced from it. This queſtion, however, is diſcuſſed under the article Egypt, where it is ſhown that this cannot poſſibly be the caſe.—Among other authorities there quoted was that of Mr Volney, who ſtrenuouſly argues againſt the opinion of Mr Savary and others, who have maintained that Egypt is the gift of the Nile. Notwithſtanding this, however, we find him aſſerting that the ſoil of Egypt has undoubtedly been augmented by the Nile, in which caſe it is not unreaſonable to ſuppoſe that it has been produced by it altogether.—" The reader (ſays he) will conclude, doubtleſs, from what I have ſaid, that writers have flattered themſelves too much in ſuppoſing they could fix the preciſe limits of the enlargement and riſe of the Delta. But, though I would reject all illuſory circumſtances, I am far from denying the fact to be well founded; it is plain from reaſon, and an examination of the country. The riſe of the ground appears to me demonſtrated by an obſervation on which little ſtreſs has been laid. In going from Roſetta to Cairo, when the waters are low, as in the month of March, we may remark, as we go up the river, that the ſhore riſes gradually above the water; ſo that if overflowed two feet at Roſetta, it overflows from three to four at Faona, and upwards of twelve at Cairo (A). Now by reaſoning from this fact, we may deduce the proof of an increaſe by ſediment; for the layer of mud being in proportion to the thickneſs of the ſheets of water by which it is depoſited, muſt be more or leſs conſiderable

(A) " It would be curious to aſcertain in what proportion it continues up to Aſouan. Some Copts, whom I have interrogated on the ſubject, aſſured me that it was much higher through all the Said than at Cairo."

Nile.

considerable as these are of a greater or less depth; and we have seen that the like gradation is observable from Asouan to the sea.

"On the other hand, the increase of the Delta manifests itself in a striking manner, by the form of Egypt along the Mediterranean. When we consider its figure on the map, we perceive that the country which is in the line of the river, and evidently formed of foreign materials, has assumed a semicircular shape, and that the shores of Arabia and Africa, on each side, have a direction towards the bottom of the Delta; which manifestly discovers that this country was formerly a gulf, that in time has been filled up.

"This accumulation is common to all rivers, and is accounted for in the same manner in all: the rain water and the snow descending from the mountains into the valleys, hurry incessantly along with them the earth they wash away in their descent. The heavier parts, such as pebbles and sands, soon stop, unless forced along by a rapid current. But when the waters meet only with a fine and light earth, they carry away large quantities with the greatest facility. The Nile, meeting with such a kind of earth in Abyssinia and the interior parts of Africa, its waters are loaded and its bed filled with it; nay, it is frequently so embarrassed with this sediment as to be straitened in its course. But when the inundation restores to it its natural energy, it drives the mud that has accumulated towards the sea, at the same time that it brings down more for the ensuing season; and this, arrived at its mouth, heaps up, and forms shoals, where the declivity does not allow sufficient action to the current, and where the sea produces an equilibrium of resistance. The stagnation which follows occasions the grosser particles, which till then had floated, to sink; and this takes place more particularly in those places where there is least motion, as towards the shores, till the sides become gradually enriched by the spoils of the upper country and of the Delta itself; for if the Nile takes from Abyssinia to give to the Thebais, it likewise takes from the Thebais to give to the Delta, and from the Delta to carry to the sea. Wherever its waters have a current, it despoils the same territory that it enriches. As we ascend towards Cairo, when the river is low, we may observe the banks worn steep on each side and crumbling in large flakes. The Nile, which undermines them, depriving their light earth of support, it falls into the bed of the river; for when the water is high, the earth imbibes it; and when the sun and drought return, it cracks and moulders away in great flakes, which are hurried along by the Nile."

Thus does Mr Volney argue for the increase of the Delta in the very same manner that others have argued for the production of the whole country of Egypt; an opinion which he is at great pains to refute. Under the article Egypt, however, it is shown that the Nile does not bring down any quantity of mud sufficient for the purposes assigned; and with regard to the argument drawn from the shallowness of the inundation when near the sea, this does not prove any rise of the land; but as Mr Rennel has judiciously observed in his remarks on the inundation of the Ganges, arises from the nature of the fluid itself. The reason, in short, is this: The surface of the sea is the lowest point to which the waters of every inundation have a tendency; and when they arrive there, they spread themselves over it with more ease than anywhere else, because they meet with less resistance. Their motion, however, by reason of the small declivity, is less swift than that of the waters farther up the river, where the declivity is greater; and consequently the latter being somewhat impeded in their motion, are in some degree accumulated. The surface of the inundation, therefore, does not form a perfectly level plain, but one gradually sloping from the interior parts of the country towards the sea; so that at the greatest distance from the ocean the water will always be deepest, even if we should suppose the whole country to be perfectly smooth, and composed of the most solid materials.—This theory is easily understood from observing a quantity of water running along a wooden spout, which is always more shallow at the end of the spout where it runs off than at the others.—With regard to Mr Volney's other arguments, they are without doubt contradictory; for if, as he says, the river takes from Abyssinia to give to the Thebais, from Thebais to give to the Delta, and from Delta to the sea, it undoubtedly follows, that it gives nothing to any part of the land whatever, but that altogether is swept into the Mediterranean sea; which, indeed, some very trifling quantities excepted, is most probably the case.

It has been remarked by Mr Pococke, a very judicious traveller, that, in the beginning of the inundation, the waters of the Nile run red, and sometimes green; and while they remain of that colour, they are unwholesome. He explains this phenomenon by supposing, that the inundation at first brings away that red or green filth which may be about the lakes where it takes its rise; or about the sources of the small rivers which flow into it, near its principal source; "for, says he, although there is so little water in the Nile when at lowest, that there is hardly any current in many parts of it, yet it cannot be supposed that the water should stagnate in the bed of the Nile so as to become green. Afterwards the water begins to be red and still more turbid, and then it begins to be wholesome." This circumstance is explained by Mr Bruce in the following manner: The country about Narea and Caffa, where the river Abiad takes its rise, is full of immense marshes, where, during the dry season, the water stagnates, and becomes impregnated with every kind of corrupted matter. These, on the commencement of the rains, overflow into the river Abiad, which takes its rise there. The overflowing of these vast marshes first carries the discoloured water into Egypt; after which follows that of the great lake Tzana, through which the Nile passes; which having been stagnated, and without rain, under a scorching sun for six months, joins its putrid waters to the former. In Abyssinia also, there are very few rivers that run after November, but all of them stand in prodigious pools, which, by the heat of the sun, likewise turn putrid, and on the commencement of the rains throw off their stagnant water into the Nile; but at last, the rains becoming constant, all this putrid matter is carried off, and the sources of the inundation become sweet and wholesome. The river then passing through the kingdom of Sennaar, the soil of which is this red bole, becomes coloured with that earth; and a mixture, along with the moving sands of the deserts, of which it

receives

Nile. receives a great quantity when raifed by the wind, precipitates all the vifcous and putrid matters which float in the waters; whence Mr Pococke judicioufly obferves, that the Nile is not wholefome when the water is clear and green, but when fo red and turbid that it ftains the water of the Mediterranean.

The rains in Abyffinia, which ceafe about the 8th of September, generally leave a fickly feafon in the low country; but the difeafes produced by thefe rains are removed by others which come on about the end of October, and ceafe about the 8th of November. On thefe rains depend the latter crops of the Abyffinians; and for thefe the Agows pray to the river, or the genius or fpirit refiding in it. In Egypt, however, the effect of them is feldom perceived; but in fome years they prove exceffive; and it has been obferved that the Nile, after it has fallen, has again rifen in fuch a manner as to alarm the whole country. This is faid to have happened in the time of Cleopatra, when it was fuppofed to prefage the extinction of the government of the Ptolemies; and in 1737 it was likewife imagined to portend fome dreadful calamity.

The quantity of rain, by which all this inundation is occafioned, varies confiderably in different years, at leaft at Gondar, where Mr Bruce had an opportunity of meafuring it. In 1770 it amounted to $35\frac{1}{2}$ inches; but in 1771 it amounted to no lefs than 41,355 inches from the vernal equinox to the 8th of September. What our author adds concerning the variation of the rainy months feems totally irreconcilable with what he had before advanced concerning the extreme regularity of the natural caufes by which the tropical rains are produced. "In 1770 (fays he) Auguft was the rainy month; in 1771, July. When July is the rainy month, the rains generally ceafe for fome days in the beginning of Auguft, and then a prodigious deal falls in the latter end of that month and firft week of September. In other years July and Auguft are the violent rainy months, while June is fair. And laftly, in others, May, June, July, Auguft, and the firft week of September." If this is the cafe, what becomes of the regular attraction of the clouds by the fun as he advances northwards; of the coming on of the rains when he arrives at the zenith of any place, in his paffage to the tropic of Cancer; and of their ceafing when he comes to the fame point in his return fouthward?

Under ABYSSINIA we have mentioned a threat of one of the Abyffinian monarchs, that he would direct the courfe of the Nile and prevent it from fertilizing the land of Egypt; and it has likewife been related, that confiderable progrefs was made in this undertaking by another emperor. Mr Bruce has beftowed an entire chapter on the fubject; and is of opinion, that "there feems to be no doubt that it is poffible to diminifh or divert the courfe of the Nile, that it fhould be infufficient to fertilize the country of Egypt; becaufe the Nile, and all the rivers that run into it, and all the rains that fwell thefe rivers, fall in a country two miles above the level of the fea; therefore it cannot be denied, that there is level enough to divert many of the rivers into the Red fea, or perhaps ftill eafier by turning the courfe of the river Abiad till it meets the level of the Niger, or pafs through the defert into the Mediterranean. Alphonfo Albuquerque is faid to have written frequently to the king of Portugal to fend him pioneers from Madeira, with people accuftomed to level grounds, and prepare them for fugar canes; by whofe affiftance he meant to turn the Nile into the Red fea. This undertaking, however, if it really had been projected, was never accomplifhed; nor indeed is there any probability that ever fuch a mad attempt was propofed. Indeed, though we cannot deny that there is a poffibility in nature of accomplifhing it, yet the vaft difficulty of turning the courfe of fo many large rivers may juftly ftigmatize it as impracticable; not to mention the obftacles which muft naturally be fuggefted from the apparent inutility of the undertaking, and thofe which would arife from the oppofition of the Egyptians. Nile.

It has already been obferved in a quotation from the reviewers, that Herodotus was informed by the facriftan or fecretary of the treafury of Minerva, that one half of the waters of the Nile run north and the other fouth. This is alfo taken notice of by Mr Bruce; who gives the following explanation of it. "The fecretary was probably of that country himfelf, and feems by his obfervation to have known more of it than all the ancients together. In fact we have feen, that between 13° and 14° north latitude, the Nile, with all its tributary ftreams, which have their rife and courfe within the tropical rains, falls down into the flat country (the kingdom of Sennaar), which is more than a mile lower than the high country in Abyffinia; and thence, with a little inclination, it runs into Egypt. Again, In latitude 9°, in the kingdom of Gingiro, the Zebee runs fouth or fouth-eaft, into the Inner Ethiopia, as do alfo many other rivers, and, as I have heard from the natives of that country empty themfelves into a lake, as thofe on the north fide of the line do into the lake Tzana, thence diftributing their waters to the eaft and weft. Thefe become the heads of great rivers, that run through the interior countries of Ethiopia (correfponding to the fea coaft of Melinda and Mombaza) into the Indian ocean; whilft, on the weftward, they are the origin of the vaft ftreams that fall into the Atlantic, paffing through Benin and Congo, fouthward of the river Gambia and the Sierra Leona. In fhort, the periodical rains from the tropic of Capricorn to the line, being in equal quantity with thofe that fall between the line and the tropic of Cancer, it is plain, that if the land of Ethiopia floped equally from the line fouthward and northward, the rains that fall would go, the one half north and the other half fouth; but as the ground from 5° north declines all fouthward, it follows, that the rivers which run to the fouthward muft be equal to thofe that run northward, *plus* the rain that falls in the 5° north latitude, where the ground begins to flope to the fouthward; and there can be little doubt that is at leaft one of the reafons why there are in the fouthern continent fo many rivers larger than the Nile, that run both into the Indian and Atlantic oceans."

From this account given to Herodotus, it has been fuppofed, by fome writers on geography, that the Nile divides itfelf into two branches, one of which runs northward into Egypt, and one through the country of the Negroes weftward into the Atlantic ocean. This opinion was firft broached by Pliny.— It has been adopted by the Nubian geographer, who urges

urges in ſupport of it, that if the Nile carried down all the rains which fall into it from Abyſſinia, the people of Egypt would not be ſafe in their houſes. But to this Mr Bruce anſwers, that the waſte of water in the burning deſerts through which the Nile paſſes is ſo great, that unleſs it was ſupplied by another ſtream, the White River, equal in magnitude to itſelf, and which, riſing in a country of perpetual rains, is thus always kept full, it never could reach Egypt at all, but would be loſt in the ſands, as is the caſe with many other very conſiderable rivers in Africa. "The rains (ſays he) are collected by the four great rivers in Abyſſinia; the Mareb, the Bowiha, the Tacazze, and the Nile. All theſe principal, and their tributary ſtreams, would, however, be abſorbed, nor be able to paſs the burning deſerts, or find their way into Egypt, were it not for the White River, which having its ſource in a country of almoſt perpetual rains, joins to it a never-failing ſtream equal to the Nile itſelf."

We ſhall conclude this article with ſome account of the Agows who inhabit the country about the ſources of the Nile. Theſe, according to Mr Bruce, are one of the moſt conſiderable nations in Abyſſinia, and can bring into the field about 4000 horſe and a great number of foot; but were once much more powerful than they are now, having been greatly reduced by the invaſions of the Galla. Their province is nowhere more than 60 miles in length, or than 30 in breadth; notwithſtanding which they ſupply the capital and all the neighbouring country with cattle, honey, butter, wax, hides, and a number of other neceſſary articles; whence it has been cuſtomary for the Abyſſinian princes to exact a tribute rather than military ſervice from them. The butter is kept from putrefaction during the long carriage, by mixing it with a ſmall quantity of a root ſomewhat like a carrot, which they call *mormoco*. It is of a yellow colour, and anſwers the purpoſe perfectly well; which in that climate it is very doubtful if ſalt could do. The latter is beſides uſed as money; being circulated inſtead of ſilver coin, and uſed as change for gold. Brides paint their feet, hands, and nails, with this root. A large quantity of the ſeed of the plant was brought into Europe by Mr Bruce.

The Agows carry on a conſiderable trade with the Shangalla and other black ſavages in the neighbourhood; exchanging the produce of their country for gold, ivory, horns of the rhinoceros, and ſome fine cotton. The barbarity and thieviſh diſpoſition of both nations, however, render this trade much inferior to what it might be.

In their religion the Agows are groſs idolaters, paying divine honours to the Nile, as has already been obſerved. Mr Bruce, who lodged in the houſe of the prieſt of the river, had an opportunity of becoming acquainted with many particulars of their devotion. He heard him addreſs a prayer to the Nile, in which he ſtyled it the "Moſt High God, the Saviour of the world. In this prayer he petitioned for ſeaſonable rain, plenty of graſs, and the preſervation of a kind of ſerpents; deprecating thunder very pathetically. The moſt ſublime and lofty titles are given by them to the ſpirit which they ſuppoſe to reſide in the river Nile; calling it everlaſting God, Light of the World, Eye of the World, God of Peace, their Saviour, and Father of the Univerſe.

The Agows are all clothed in hides, which they manufacture in a manner peculiar to themſelves. Theſe hides are made in the form of a ſhirt reaching down to their feet, and tied about the middle with a kind of ſaſh or girdle. The lower part of it reſembles a large double petticoat, one fold of which they turn back over their ſhoulders, faſtening it with a broach or ſkewer acroſs their breaſt before, and the married women carry their children in it behind. The younger ſort generally go naked. The women are marriageable at nine years of age, though they commonly do not marry till eleven; and they continue to bear children till 30, and ſometimes longer. They are generally thin and below the middle ſize, as well as the men. Barrenneſs is quite unknown among them.

The country of the Agows has a very elevated ſituation, and is of courſe ſo temperate that the heat may eaſily be borne, though little more than 10° from the equator. The people, however, are but ſhort lived; which may in part be owing to the oppreſſion they labour under. This, according to Mr Bruce, is exceſſive. "Though their country (ſays he) abounds with all the neceſſaries of life, their taxes, tributes, and ſervices, eſpecially at preſent, are ſo multiplied upon them, whilſt their diſtreſſes of late have been ſo great and frequent, that they are only the manufacturers of the commodities they ſell, to ſatisfy theſe conſtant exorbitant demands, and cannot enjoy any part of their own produce themſelves, but live in penury and miſery ſcarcely to be conceived. We ſaw a number of women wrinkled and ſun-burnt ſo as ſcarcely to appear human, wandering about under a burning ſun, with one and ſometimes two children upon their backs; gathering the ſeeds of bent graſs to make a kind of bread.

NILOMETER, or Niloscope, an inſtrument uſed among the ancients to meaſure the height of the water of the river Nile in its overflowings.

The word comes from Νειλος Nile (and that from νεα ιλυς "new mud," or as ſome others would have it, from νεω, "I flow," and ιλυς, "mud,") and μετρον, "meaſure." The Greeks more ordinarily call it, Νειλοσκοπιον.

The nilometer is ſaid, by ſeveral Arabian writers, to have been firſt ſet up, for this purpoſe, by Joſeph during his regency in Egypt: the meaſure of it was 16 cubits, this being the height of the increaſe of the Nile, which was neceſſary to the fruitfulneſs of Egypt.

From the meaſure of this column, Dr Cumberland * deduces an argument, in order to prove that the Jewiſh and Egyptian cubits were of the ſame length.

* *Scripture Weights and Meaſures*, p. 18.

In the French king's library is an Arabic treatiſe on nilometers, entitled *Neil ſi alnal al Nil*; wherein are deſcribed all the overflowings of the Nile, from the firſt year of the Hegira to the 875th.

Herodotus mentions a column erected in a point of the iſland Delta, to ſerve as a nilometer; and there is ſtill one of the ſame kind in a moſque of the ſame place.

As all the riches of Egypt ariſe from the inundations of the Nile, the inhabitants uſed to ſupplicate them at the hands of their Serapis; and committed the moſt execrable crimes, as actions, forſooth, of religion, to obtain the favour. This occaſioned Conſtantine expreſsly to

Nilometer || Nimeguen.

to prohibit these sacrifices, &c. and to order the nilometer to be removed into the church; whereas, till that time, it had been in the temple of Serapis. Julian the Apostate had it replaced in the temple, where it continued till the time of Theodosius the Great.

The following is Mr Bruce's account of the nilometer. "On the point † of the island Rhode, between Geeza and Cairo, near the middle of the river, is a round tower enclosing a neat well or cistern lined with marble. The bottom of this well is on the same level with the bottom of the Nile, which has free access to it through a large opening like an embrasure. In the middle of the well rises a thin column of eight faces of blue and white marble; of which the foot is on the same plane with the bottom of the river. This pillar is divided into 20 peeks, of 22 inches each. Of these peeks the two lowermost are left, without any division, to stand for the quantity of sludge which the water deposits there. Two peeks are then divided, on the right hand, into 24 digits each; then on the left, four peeks are divided into 24 digits; then on the right, four; and on the left another four: again, four on the right, which completes the number of 18 peeks from the first division marked on the pillar, each peek being 22 inches. Thus the whole marked and unmarked amounts to something more than 36 feet English.

† *Bruce's Travels*, vol. iii.

On the night of St John, when, by the falling of the dew, they perceive the rain water from Ethiopia mixed with the Nile at Cairo, they begin to announce the elevation of the river, having then five pecks of water marked on the nilometer, and two unmarked for the sludge, of which they take no notice. Their first proclamation, supposing the Nile to have risen 12 digits, is 12 from 6, or it wants 12 digits to be six peeks. When it has risen three more, it is nine from six; and so on, till the whole 18 be filled, when all the land of Egypt is fit for cultivation. Several canals are then opened, which convey the water into the desert, and hinder any further stagnation on the fields. There is indeed a great deal of more water to come from Ethiopia; but were the inundation suffered to go on, it would not drain soon enough to fit the land for tillage: and to guard against this mischief is the principal use of the nilometer, though the Turkish government makes it an engine of taxation. From time immemorial the Egyptians paid, as tribute to the king, a certain proportion of the fruit of the ground; and this was anciently ascertained by the elevation of the water on the nilometer, and by the mensuration of the land actually overflowed. But the Saracen government, and afterwards the Turkish, has taxed the people by the elevation alone of the water, without attending to its course over the country, or the extent of the land actually overflowed; and this tax is sometimes cruelly oppressive.

NIMBUS, in antiquity, a circle observed on certain medals, or round the heads of some emperors; answering to the circles of light drawn round the images of saints.

NIMEGUEN, a large, handsome, and strong town of the Netherlands, and capital of Dutch Guelderland, with a citadel, an ancient palace, and several forts. It is noted for the peace concluded there in 1695. It has a magnificent town-house, and the inhabitants are greatly given to trade. It is seated on the Vahal or Wahal, between the Rhine and the Maese. It is the utmost eastern boundary of the Netherlands. It contains two Dutch churches, a French Calvinist and a Lutheran church, five Popish, and several hospitals. It was once a Hans-town and an imperial city. It was once the seat of government, has a canal to Arnheim, and considerable trade to some parts of Germany: it trades also in fine beer brewing, fattening of cattle, and exporting of its butter, which is extremely good, into all the other provinces. It was taken by the French in 1794. It is in E. Long. 5. 45. N. Lat. 51. 55.

Nimetulahites || Nimrod.

NIMETULAHITES, a kind of Turkish monks, so called from their founder Nimetulahi, famous for his doctrines and the austerity of his life.

NIMPO, a city and sea-port town of China, in the province of Chekiang. It is seated on the eastern sea of China over against Japan. It is a city of the first rank, and stands at the confluence of two small rivers, which, after their union, form a channel that reaches to the sea, and is deep enough to bear vessels of 200 tons burden. The walls of Nimpo are 5000 paces in circumference, and are built with freestone. There are five gates, besides two water gates for the passage of barks into the city; a tower several stories high, built of bricks; and a long bridge of boats, fastened together with iron chains, over a very broad canal. This city is commanded by a citadel built on a very high rock, by the foot of which all vessels must necessarily pass. The Chinese merchants of Siam and Batavia go to this place yearly to buy silks, which are the finest in the empire. They have also a great trade with Japan, it being but two days sail from hence: thither they carry silks, stuffs, sugar, drugs, and wine; and bring back copper, gold, and silver. E. Long. 122. 0. N. Lat. 30. 0.

NIMROD, the sixth son of Cush, and in all appearance much younger than any of his brothers: for Moses mentions the sons of Raamah, his fourth brother, before he speaks of him. What the sacred historian says of him is short; and yet he says more of him than of any other of the posterity of Noah, till he comes to Abraham. He tells us, that "Nimrod began to be a mighty one in the earth;" that he was a "mighty hunter before the Lord," even to a proverb; and that "the beginning of his kingdom was Babel, and Erech, and Accad, and Calneh, in the land of Shinar."

From this account he is supposed to have been a man of extraordinary strength and valour. Some represent him as a giant; all consider him as a great warrior. It is generally thought, that by the words *a mighty hunter*, is to be understood, that he was a great tyrant; but some of the rabbins interpret those words favourably, saying, that Nimrod was qualified by a peculiar dexterity and strength for the chase, and that he offered to God the game which he took; and several of the moderns are of opinion, that this passage is not to be understood of his tyrannical oppressions, or of hunting of men, but of beasts. It must be owned, that the phrase *before the Lord* may be taken in a favourable sense, and as a commendation of a person's good qualities; but in this place the generality of expositors understand it otherwise.

Hunting must have been one of the most useful employments in the times just after the dispersion, when all countries were over-run with wild beasts, of which it was necessary they should be cleared, in order to make them habitable; and therefore nothing seemed more proper to procure a man esteem and honour in those ages, Nimrod.

ages, than his being an expert hunter. By that exercise, we are told, the ancient Persians fitted their kings for war and government; and hunting is still, in many countries, considered as one part of a royal education.

There is nothing in the short history of Nimrod which carries the least air of reproach, except his name, which signifies a *rebel;* and that is the circumstance which seems to have occasioned the injurious opinions which have been entertained of him in all ages. Commentators, being prepossessed in general that the curse of Noah fell upon the posterity of Ham, and finding this prince stigmatized by his name, have interpreted every passage relating to him to his disadvantage. They represent him as a rebel against God, in persuading the descendants of Noah to disobey the divine command to disperse, and in setting them to build the tower of Babel, with an impious design of scaling heaven. They brand him as an ambitious usurper, and an insolent oppressor; and make him the author of the adoration of fire, of idolatrous worship given to men, and the first persecutor on the score of religion. On the other hand, some account him a virtuous prince, who, far from advising the building of Babel, left the country, and went into Assyria, because he would not give his consent to that project.

Nimrod is generally thought to have been the first king after the flood; though some authors, supposing a plantation or dispersion prior to that of Babel, have made kings in several countries before his time. Mizraim is thought, by many who contend for the antiquity of the Egyptian monarchy, to have begun his reign much earlier than Nimrod; and others, from the uniformity of the languages spoken in Assyria, Babylonia, Syria, and Canaan, affirm those countries to have been peopled before the confusion of tongues.

The four cities Moses gives to Nimrod constituted a large kingdom in those early times, when few kings had more than one; only it must be observed, that possessions might at first have been large, and afterwards divided into several parcels; and Nimrod being the leader of a nation, we may suppose his subjects settled within those limits: whether he became possessed of those cities by conquest or otherwise, does not appear; it is most probable he did not build Babel, all the posterity of Noah seeming to have been equally concerned in that affair; nor does it appear that he built the other three, though the founding of them, and many more, with other works, are attributed to him by some authors. It may seem also a little strange, that Nimrod should be preferred to the regal dignity, and enjoy the most cultivated part of the earth then known, rather than any other of the elder chiefs or heads of nations, even of the branch of Ham. Perhaps it was conferred on him for his dexterity in hunting; or, it may be, he did not assume the title of king till after his father Cush's death, who might have been settled there before him, and left him the sovereignty; but we incline to think, that he seized Shinar from the descendants of Shem, driving out Ashur, who from thence went and founded Nineveh, and other cities in Assyria.

The Scripture does not inform us when Nimrod began his reign: Some date it before the dispersion; but such a conjecture does not seem to suit with the Mosaical history; for before the dispersion we read of no city but Babel; nor could there well be more, while all mankind were yet in a body together; but when Nimrod assumed the regal title, there seem to have been other cities; a circumstance which shows it was a good while after the dispersion. The learned writers of the Universal History place the beginning of his reign 30 years from that event, and in all likelihood it should be placed rather later than earlier.

Nimrod || Nineveh.

Authors have taken a great deal of pains to find Nimrod in profane history: some have imagined him to be the same with Belus, the founder of the Babylonish empire; others take him to be Ninus, the first Assyrian monarch. Some believe him to have been Evechous, the first Chaldean king after the deluge; and others perceive a great resemblance between him and Bacchus, both in actions and name. Some of the Mohammedan writers suppose Nimrod to have been Zohak, a Persian king of the first dynasty: others contend for his being Cay Caus, the second king of the second race; and some of the Jews say he is the same with Amraphel the king of Shinar, mentioned by Moses. But there is no certainty in these conjectures, nor have we any knowledge of his immediate successors.

The Scripture mentions nothing as to the death of Nimrod; but authors have taken care that such an essential circumstance in his history should not be wanting. Some of the rabbins pretend he was slain by Esau, whom they make his contemporary. There is a tradition that he was killed by the fall of the tower of Babel, which was overthrown by tempestuous winds. Others say, that as he led an army against Abraham, God sent a squadron of gnats, which destroyed most of them, and particularly Nimrod, whose brain was pierced by one of those insects.

NINE, the last of the radical numbers or characters; from the combination of which any definite number, however large, may be produced. "It is observed by arithmeticians (says Hume), that the products of 9 compose always either 9 or some lesser products of 9, if you add together all the characters of which any of the former products is composed: thus of 18, 27, 36, which are products of 9, you make 9, by adding 1 to 8, 2 to 7, 3 to 6. Thus 369 is a product also of 9; and if you add 3, 6, and 9, you make 18, a lesser product of 9." See *Hume's Dialogues on Nat. Relig.* p. 167, 168, &c. 2d. edit.

NINEVEH, in *Ancient Geography*, the capital city of Assyria, founded by Ashur the son of Shem (Gen. x. 11.); or, as others read the text, by Nimrod the son of Cush.

However this be, yet it must be owned, that Nineveh was one of the most ancient, the most famous, the most potent, and largest cities of the world. It is very difficult exactly to assign the time of its foundation; but it cannot be long after the building of Babel. It was situated upon the banks of the Tigris; and in the time of the prophet Jonas, who was sent thither under Jeroboam II. king of Israel, and, as Calmet thinks, under the reign of Pul, father of Sardanapalus, king of Assyria, Nineveh was a very great city, its circuit being three days journey (Jonah iii. 3.) Diodorus Siculus, who has given us the dimensions of it, says it was 480 stadia in circumference, or 47 miles; and that it was surrounded with lofty walls and towers; the former being 200 feet in height, and so very broad that three chariots might drive on them abreast; and the latter 200 feet in height, and 1500 in number; and Strabo allows it to have been much

Nineveh, Ninia.

much greater than Babylon. Diodorus Siculus was, however, certainly miſtaken, or rather his tranſcribers, as the authors of the Univerſal Hiſtory think, in placing Nineveh on the Euphrates, ſince all hiſtorians as well as geographers who ſpeak of that city, tell us in expreſs terms that it ſtood on the Tigris. At the time of Jonah's miſſion thither, it was ſo populous, that it was reckoned to contain more than ſix ſcore thouſand perſons, who could not diſtinguiſh their right hand from their left (Jonah iv. 11.), which is generally explained of young children that had not yet attained to the uſe of reaſon; ſo that upon this principle it is computed that the inhabitants of Nineveh were then above 600,000 perſons.

Nineveh was taken by Arbaces and Beleſis, in the year of the world 3257, under the reign of Sardanapalus, in the time of Ahaz king of Judah, and about the time of the foundation of Rome. It was taken a ſecond time by Aſtyages and Nabopolaſſar from Chynaladanus king of Aſſyria in the year 3378. After this time, Nineveh no more recovered its former ſplendour. It was ſo entirely ruined in the time of Lucianus Samoſatenſis, who lived under the emperor Adrian, that no footſteps of it could be found, nor ſo much as the place where it ſtood. However, it was rebuilt under the Perſians, and deſtroyed again by the Saracens about the ſeventh age.

Modern travellers ſay (A), that the ruins of ancient Nineveh may ſtill be ſeen on the eaſtern banks of the Tigris, oppoſite to the city Moſul or Mouſul: (See Mousul). Profane hiſtorians tell us, that Ninus firſt founded Nineveh; but the Scripture aſſures us, that it was Aſhur or Nimrod.

The ſacred authors make frequent mention of this city; and Nahum and Zephaniah foretold its ruin in a very particular and pathetic manner.

NINIA, or Ninian, commonly called *St Ninian*, a holy man among the ancient Britons. He reſided at or near a place called by Ptolemy *Leucopibia*, and by Bede *Candida Caſa;* but the Engliſh and Scotch called it *Whithorne*. We mention him, becauſe he is ſaid to have been the firſt who converted the Scots and Picts to the Chriſtian faith; which he did during the reign of Theodoſius the Younger. Bede informs us, that he built a church dedicated to St Martin, in a ſtyle unknown to the Britons of that time; and adds, that during his time the Saxons held this province (*Gallovidia*, now *Galloway*), and that, as in conſequence of the labours of this ſaint the converts to Chriſtianity increaſed, an epiſcopal ſee was eſtabliſhed there. Dr Henry, conſidering that "few or none of the writings of the moſt ancient fathers of the Britiſh church are now extant, and ſince little being ſaid of them by their cotemporaries, we can know little of their perſonal hiſtory and of the extent of their erudition," gives a ſhort account of ſome of them. Of St Ninian he ſays, "he was a Briton of noble birth and excellent genius. After he had received as good an education at home as his own country could afford, he travelled for his further improvement, and ſpent ſeveral years at Rome, which was then the chief ſeat of learning as well as of empire. From thence he returned into Britain, and ſpent his life in preaching the goſpel in the moſt uncultivated parts of it, with equal zeal and ſucceſs."

Ning-po-fou, Ninon.

There is a ſmall town called *St Ninian*, about a mile ſouth of Stirling. Its church had been occupied by the rebels in 1745 as a powder magazine; who on their return blew it up in ſuch haſte, as to deſtroy ſome of their own people and about fifteen ſpectators.

NING-PO-FOU, called by the Europeans *Liampo*, is an excellent port, on the eaſtern coaſt of China, oppoſite to Japan. Eighteen or twenty leagues from this place is an iſland called *Tcheou-chan*, where the Engliſh firſt landed on their arrival at China.

The ſilks manufactured at Ning-po are much eſteemed in foreign countries, eſpecially in Japan, where the Chineſe exchange them for copper, gold, and ſilver. This city has four others under its juriſdiction, beſides a great number of fortreſſes.

NINON L'Enclos, a celebrated lady in the court of France, was of a noble family, and born at Paris in the year 1615; but rendered herſelf famous by her wit and gallantries. Her mother was a lady of exemplary piety; but her father early inſpired her with the love of pleaſure. Having loſt her parents at 14 years of age, and finding herſelf miſtreſs of her own actions, ſhe reſolved never to marry: ſhe had an income of 10,000 livres a-year; and, according to the leſſons ſhe had received from her father, drew up a plan of life and gallantry, which ſhe purſued till her death. Never delicate with reſpect to the number, but always in the choice, of her pleaſures, ſhe ſacrificed nothing to intereſt; but loved only while her taſte for it continued; and had among her admirers the greateſt lords of the court. But notwithſtanding the levity of her conduct, ſhe had many virtues.—She was conſtant in her friendſhip, faithful to what are called the *laws of honour*, of ſtrict veracity, diſintereſted, and more particularly remarkable for perfect probity. Women of the moſt reſpectable characters were proud of the honour of having her for their friend; at her houſe was an aſſemblage

(A) This aſſertion, however, is far from ſeeming probable; for every trace of it ſeems to have ſo totally diſappeared, even ſo early as A. D. 627, that the vacant ſpace afforded a ſpacious field for the celebrated battle between the emperor Heraclius and the Perſians. There are few things in ancient hiſtory which have more puzzled the learned world, than to determine the ſpot where this city ſtood. Mr Ives informs us, that ſome have imagined it ſtood near Jonah's tomb; others, however, place it at another place, ſome hours journey up the Tigris. Theſe different opinions, however, ſeem perfectly reconcilable; for it appears at leaſt probable, that ancient Nineveh took in the whole of the ground which lies between theſe two ruined places. Mr Ives adds, that "what confirms this conjecture is, that much of this ground is now hilly, owing no doubt to the rubbiſh of the ancient buildings. There is one mount of 200 or 300 yards ſquare, which ſtands ſome yards north-eaſt of Jonah's tomb, whereon it is likely a fortification once ſtood. It ſeems to have been made by nature, or perhaps both by nature and art, for ſuch an uſe."

Ninth ‖ Niobe.

femblage of every thing moft agreeable in the city and the court; and mothers were extremely defirous of fending their fons to that fchool of politenefs and good tafte, that they might learn fentiments of honour and probity, and thofe other virtues that render men amiable in fociety. But the illuftrious Madame de Sevigné with great juftnefs remarks in her letters, that this fchool was dangerous to religion and the Chriftian virtues; becaufe Ninon L'Enclos made ufe of feducing maxims, capable of depriving the mind of thofe invaluable treafures. Ninon was efteemed beautiful even in old age; and is faid to have infpired violent paffions at 80. She died at Paris in 1705. This lady had feveral children; one of whom, named *Chevalier de Villiers*, excited much attention by the tragical manner in which he ended his life. He became in love with Ninon, without knowing that fhe was his mother; and when he difcovered the fecret of his birth, ftabbed himfelf in a fit of defpair. There have been publifhed the pretended Letters of Ninon L'Enclos to the Marquis de Sevigné.

NINTH, in *Mufic*. See INTERVAL.

NINUS, the firft king of the Affyrians, was, it is faid, the fon of Belus. It is added, that he enlarged Nineveh and Babylon; conquered Zoroafter king of the Bactrians; married Semiramis of Afcalon; fubdued almoft all Afia; and died after a glorious reign of 52 years, about 1150 B. C.; but all thefe facts are uncertain. See SEMIRAMIS.

NIO, an ifland of the Archipelago, between Naxi to the north, Armago to the eaft, Santerino to the fouth, and Sikino to the weft, and is about 35 miles in circumference. It is remarkable for nothing but Homer's tomb, which they pretend is in this ifland; for they affirm that he died here in his paffage from Samos to Athens. The ifland is well cultivated, and not fo fteep as the other iflands, and the wheat which it produces is excellent; but oil and wood are fcarce. It is fubject to the Turks. E. Long. 25. 35. N. Lat. 36. 43.

NIOBE, in fabulous hiftory, according to the fictions of the poets, was the daughter of Tantalus, and wife of Amphion king of Thebes; by whom fhe had feven fons and as many daughters. Having become fo proud of her fertility and high birth, as to prefer herfelf before Latona, and to flight the facrifices offered up by the Theban matrons to that goddefs, Apollo and Diana, the children of Latona, refented this contempt. The former flew the male children and the latter the female; upon which Niobe was ftruck dumb with grief, and remained without fenfation. Cicero is of opinion, that on this account the poets feigned her to be turned into ftone.

The ftory of Niobe is beautifully related in the fixth book of the Metamorphofes of Ovid. That poet thus defcribes her transformation into ftone.

Widow'd and childlefs, lamentable ftate!
A doleful fight, among the dead fhe fat;
Harden'd with woes, a ftatue of defpair,
To ev'ry breath of wind unmov'd her hair;
Her cheek ftill redd'ning, but its colour dead,
Faded her eyes, and fet within her head.
No more her pliant tongue its motion keeps,
But ftands congeal'd within her frozen lips.
Stagnate and dull, within her purple veins,
Its current ftopp'd, the lifelefs blood remains.
Her feet their ufual offices refufe,
Her arms and neck their graceful geftures lofe:
Action and life from every part are gone,
And ev'n her entrails turn to folid ftone.
Yet ftill fhe weeps; and whirl'd by ftormy winds,
Borne thro' the air, her native country finds;
There fix'd, fhe ftands upon a bleaky hill;
There yet her marble cheeks eternal tears diftil.

Niobe. Niobe in this ftatue is reprefented as in an ecftacy of grief for the lofs of her offspring, and about to be converted into ftone herfelf. She appears as if deprived of all fenfation by the excefs of her forrow, and incapable either of fhedding tears or of uttering any lamentations, as has been remarked by Cicero in the third book of his Tufculan Queftions. With her right hand fhe clafps one of her little daughters, who throws herfelf into her bofom; which attitude equally fhows the ardent affection of the mother, and expreffes that natural confidence which children have in the protection of a parent. The whole is executed in fuch a wonderful manner, that this, with the other ftatues of her children, is reckoned by Pliny among the moft beautiful works of antiquity: but he doubts to whom of the Grecian artifts he ought to afcribe the honour of them (A). We have no certain information at what period this celebrated work was tranfported from Greece to Rome, nor do we know where it was firft erected. Flaminius Vacca only fays, that all thefe ftatues were found in his time not far from the gate of St John, and that they were afterwards placed by the grand duke Ferdinand in the gardens of the Villa de Medici near Rome.—An ingenious and entertaining traveller (Dr Moore), fpeaking of the ftatue of Niobe, fays, "The author of Niobe has had the judgement not to exhibit all the diftrefs which he might have placed in her countenance. This confummate artift was afraid of difturbing her features too much, knowing full well that the point where he was to expect moft fympathy was there, where diftrefs co-operated with beauty, and where *our pity met our love*. Had he fought it one ftep farther in *expreffion*, he had loft it."

In the following epigram this ftatue is afcribed to Praxiteles:

Εκ ζωης με Θεοι θευ σανλιθον. Εκ δε λιθοιο
Ζωην Πραξιτελης εμπαλεν ειργασατο.

While for my children's fate I vainly mourn'd,
The angry gods to maffy ftone me turn'd;
Praxiteles a nobler feat has done,
He made me live again from being ftone.

The author of this epigram, which is to be found in the 4th book of the *Anthology*, is unknown. Scaliger the father, in his *Farrago Epigrammatum*, p. 172. afcribes it to Callimachus, but this appears to be only conjecture.

Cælius

(A) Par hæfitatio in templo Apollinis Sofiani, Niobem cum liberis morientem, Scopas an Praxiteles fecerit.

Cælius Calcagninus has made a happy translation of it into Latin.

Vivam olim in lapidem verterunt numina; sed me
Praxiteles vivam reddidit ex lapide.

And perhaps the following French version of it will appear no less happy:

De vive que j'étois, les Dieux
M'ont changée en pierre massive:
Praxitele a fait beaucoup mieux,
De pierre il m'a sçû rendre vive.

NIPHON, the largest of the Japan islands, being 600 miles long and 100 broad. See JAPAN.

NIPPERS, in the manege, are four teeth in the fore part of a horse's mouth, two in the upper, and two in the lower jaw. A horse puts them forth between the second and third year.

NIPPLES, in *Anatomy*. See MAMMÆ, ANATOMY *Index*.

NIPPLE-WORT. See LAPSANA, BOTANY *Index*.

NISAN, a month of the Hebrews, answering to our March, and which sometimes takes from February or April, according to the course of the moon. It was the first month of the sacred year, at the coming out of Egypt (Exod. xii. 2.), and it was the seventh month of the civil year. By Moses it is called Abib. The name Nisan is only since the time of Ezra, and the return from the captivity of Babylon.

On the first day of this month the Jews fasted for the death of the children of Aaron (Lev. x. 1, 2, 3.) On the tenth day was celebrated a fast for the death of Miriam the sister of Moses; and every one provided himself with a lamb for the passover. On this day the Israelites passed over Jordan under the conduct of Joshua (iv. 19.) On the fourteenth day in the evening they sacrificed the pascal lamb; and the day following, being the fifteenth, was held the solemn passover (Exod. xii. 18. &c.) The sixteenth they offered the sheaf of the ears of barley as the first fruits of the harvest of that year (Levit. xxiii. 9. &c.) The twenty-first was the octave of the passover, which was solemnized with particular ceremonies. The twenty-sixth the Jews fasted in memory of the death of Joshua. On this day they began their prayers to obtain the rains of the spring. On the twenty-ninth they called to mind the fall of the walls of Jericho.

NISI PRIUS, in *Law*, a judicial writ which lies in cases where the jury being impannelled and returned before the justices of the bank, one of the parties requests to have such a writ for the ease of the country, in order that the trial may come before the justices in the same county on their coming thither. The purport of a writ of *nisi prius* is, that the sheriff is thereby commanded to bring to Westminster the men impannelled, at a certain day, before the justices, "*nisi prius justiciarii domini regis ad assisas capiendas venerint.*"

NISIBIS, in *Ancient Geography*, a city both very ancient, very noble, and of very considerable strength, situated in a district called *Mygdonia*, in the north of Mesopotamia, towards the Tigris, from which it is distant two days journey. Some ascribe its origin to Nimrod, and suppose it to be the *Achad* of Moses. The Macedonians called it *Antiochia of Mygdonia* (Plutarch); situated at the foot of Mount Masius (Strabo). It was the Roman bulwark against the Parthians and Persians. It sustained three memorable sieges against the power of Sapor, A. D. 338, 346, and 350; but the emperor Jovianus, by an ignominious peace, delivered it up to the Persians, A. D. 363.——A colony called *Septimia Nisibitana*.——Another *Nisibis*, of Aria, (Ptolemy) near the lake Arias.

Mr Ives, who passed through this place in 1758, tells us, that "it looked pretty at a distance, being seated on a considerable eminence, at the foot of which runs a river, formerly called the *Mygdonius*, with a stone bridge of eleven arches built over it. Just by the river, at the foot of the hill, or hills (for the town is seated on two), begin the ruins of a once more flourishing place, which reach quite up to the present town. From every part of this place the most delightful prospects would appear, were the soil but properly cultivated and planted; but instead of those extensive woods of fruit trees, which Rawolf speaks of as growing near the town, not above thirty or forty straggling trees of any kind can be perceived; and instead of that great extent of arable land on which he dwells so much, a very inconsiderable number of acres are now remaining. The town itself is despicable, and streets extremely narrow, and the houses, even those which are of stone, are mean. It suffered grievously by the famine of 1757, losing almost all its inhabitants either by death or desertion. The streets presented many miserable objects, who greedily devoured rinds of cucumbers, and every other refuse article of food thrown out into the highway. Here the price of bread had risen near 4000 per cent. within the last 14 years.

NISMES, an ancient, large, and flourishing town of France, in the department of Garde, with a bishop's see, and an academy. The manufactures of cloth both of gold and silk, and of stuffs formerly known by the name of serge of Nismes, exceed that of all the rest of the province. There are several monuments of antiquity, of which the amphitheatre is the principal built by the Romans. The *maison quarrée*, or the square house, is a piece of architecture of the Corinthian order, and one of the finest in the world. The temple of Diana is in part gone to ruin. It was taken by the English in 1417. The inhabitants were all Calvinists; but Louis XIV. demolished their church in 1685, and built a castle to keep them in awe. It is seated in a delightful plain, abounding in wine, oil, game and cattle. It contains a great number of venerable relicks of Roman antiquity and grandeur, which it is not our business to describe, though it is chiefly remarkable for these and its delightful situation. It owed much to M. de Becdelievre, a late bishop there: "A prelate (says Mr Townsend) equally distinguished for wisdom, benevolence, and piety; who, by his wisdom and beneficence, in the space of 45 years, much more than doubled the number of inhabitants of Nismes; for, having found only 20,000, he had the happiness before his death of seeing 50,000 rise up to call him blessed." Mr Wraxal says "it is an ill built place, containing in itself nothing extraordinary or remarkable." A hundred fables are related concerning its origin, which is carried into times anterior by many centuries to the Roman conquests. It probably does not occupy at present the fourth part of the ground on which it formerly stood. E. Long. 4. 26. N. Lat. 43. 51.

NISROCH, a god of the Aſſyrians. Sennacherib was killed by two of his ſons while he was paying his adoration to his god Niſroch in his temple (2 Kings xix. 37.) It is not known who this god Niſroch was. The Septuagint calls him Meſrach, Joſephus calls him Araſkes. The Hebrew of Tobit publiſhed by Munſter calls him Dagon. The Jews have a ſtrange notion concerning this deity, and fancy him to have been a plank of Noah's ark. Some think the word ſignifies a dove; and others underſtand by it an eagle, which has given occaſion to an opinion, that Jupiter Belus, from whom the Aſſyrian kings pretended to be derived, was worſhipped by them under the form of an eagle, and called Niſroch. Our poet Milton gives this name to one of the rebel angels.

——In the aſſembly next up ſtood
Niſroch, of principalities the prince.
Par. Loſt, book vi. 447.

NISSOLIA, a genus of plants belonging to the diadelphia claſs, and in the natural method ranking under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

NITHSDALE, NITHISDALE, or *Niddiſdale*, a diſtrict of Dumfriesſhire in Scotland, lying to the weſtward of Annandale. It is a large and mountainous tract, deriving its name from the river Nid, which riſes on the borders of Ayrſhire, and running by Sanquhar and Dumfries, diſcharges itſelf into the Solway frith. This country was formerly ſhaded with noble foreſts, which are now almoſt deſtroyed; ſo that at preſent, nothing can be more naked, wild, and ſavage. Yet the bowels of the earth yield lead, and, as is ſaid, ſilver and gold: the mountains are covered with ſheep and black cattle; and here are ſtill ſome conſiderable remains of the ancient woods, particularly that of Holywood, three miles from Dumfries, noted for a handſome church, built out of the ruins of an ancient abbey; and alſo for being the birthplace of the famous aſtrologer, hence called *Joannes de Sacro Boſco*. Mr Pennant calls it a beautiful vale, improved in appearance by the bold curvatures of the meandering ſtream, and for ſome ſpace, he ſays, it is adorned with groves and gentlemen's ſeats.

NITOCRIS, the mother of Belſhazzar (whoſe father was Evil Merodach and his grandfather Nebuchadnezzar), was a woman of extraordinary abilities: ſhe took the burden of all public affairs upon herſelf; and, while her ſon followed his pleaſures, did all that could be done by human prudence to ſuſtain the tottering empire. She perfected the works which Nebuchadnezzar had begun for the defence of Babylon; raiſed ſtrong fortifications on the ſide of the river, and cauſed a wonderful vault to be made under it, leading from the old palace to the new, 12 feet high and 15 wide. She likewiſe built a bridge acroſs the Euphrates, and accompliſhed ſeveral other works, which were afterwards aſcribed to Nebuchadnezzar. Philoſtrates, in deſcribing this bridge, tells us, that it was built by a queen, who was a native of Media; whence we may conclude this illuſtrious queen to have been by birth a Mede. Nitocris is ſaid to have placed her tomb over one of the moſt remarkable gates of the city, with an inſcription to the following effect:

If any king of Babylon after me ſhall be in diſtreſs for money, he may open this ſepulchre, and take out as much as may ſerve him; but if he be in no real neceſſity, let him forbear, or he ſhall have cauſe to repent of his preſumption.

This monument and inſcription are ſaid to have remain untouched till the reign of Darius, who, conſidering the gate was uſeleſs, no man caring to paſs under a dead body, and being invited by the hopes of an immenſe treaſure, broke it open; but, inſtead of what he ſought, is ſaid to have found nothing but a corpſe; and another inſcription, to the following effect.

Hadſt thou not been moſt inſatiably avaricious and greedy of the moſt ſordid gain, thou wouldſt never have violated the abode of the dead.

NITHRARIA, a genus of plants belonging to the dodecandria claſs, and in the natural method ranking with thoſe of which the order is doubtful. See BOTANY *Index*.

NITRE, or SALTPETRE. See CHEMISTRY, N° 938, *et ſeq.*

Calcareous NITRE. See LIME, *Nitrate of*, CHEMISTRY *Index*.

NITROUS, any thing impregnated with nitrous air.

NITROUS Air. See CHEMISTRY *Index*.

NIVELLE, a town of the Auſtrian Netherlands, in the province of Brabant, remarkable for its abbey of canoneſſes. Here is a manufacture of cambrics, and the town enjoys great privileges. The abbey juſt mentioned is inhabited by young ladies of the firſt quality, who are not confined therein as in nunneries, but may go out and marry whenever they ſee convenient, or a proper match offers. E. Long. 4. 36. N. Lat. 50. 35.

NIVELLE de la Chauſſée (Peter Claude), a comic poet, born in Paris; acquired great reputation by inventing a new kind of entertainment, which was called the *Weeping Comedy*. Inſtead of imitating Ariſtophanes, Terence, Moliere, and the other celebrated comic poets who had preceded him; and inſtead of exciting laughter by painting the different ridiculous characters, giving ſtrokes of humour and abſurdities in conduct; he applied himſelf to repreſent the weakneſſes of the heart, and to touch and ſoften it. In this manner he wrote five comedies: 1. *La fauſſe Antipathie*. 2. *Le Prejugé à la Mode;* this piece met with great ſucceſs. 3. *Melanide*. 4. *Amour pour Amour;* and, 5. *L'Ecole des Meres*. He was received into the French academy in 1736; and died at Paris in 1754, at 63 years of age. He alſo wrote a tragedy, entitled, *Maximianus;* and an epiſtle to Clio, an ingenious didactic poem.

NIVERNOIS, an inland province of France, with the title of a *duchy*, lying on the weſt ſide of Burgundy, and between it, Bourbonnois, and Barri. It is pretty fertile in wine, fruit, and corn; except the part called *Morvant*, which is a mountainous country, and barren. There is a great deal of wood, and ſeveral iron mines; as alſo mines of pit coal, which ſerves to work their forges. This province is watered by a great number of rivers; of which the Allier, the Loire, and the Yonne, are navigable. It now forms the department of Nevers, which is alſo the name of the capital city.

NIWEGAL, a village lying on the coaſt in Pembrokeſhire, South Wales, remarkable only for the diſcovery of an immenſe quantity of the ſtumps of trees appearing below low water mark, after and during a ſtorm in the year 1590, notwithſtanding the country all round is now entirely barren of wood.

NIXAPA, a rich and conſiderable town in New Spain, with a rich convent of Dominicans. The country about it abounds in cochineal, indigo, and ſugar. E. Long. 97. 15. N. Lat. 16. 42.

NIZAM (ſays Gibbon), one of the moſt illuſtrious miniſters of the eaſt, was honoured by the caliph as an oracle of religion and ſcience; he was truſted by the ſultan as the faithful vicegerant of his power and juſtice. After an adminiſtration of 30 years, the fame of the vizier, his wealth, and even his ſervices, were transformed into crimes. He was overthrown by the inſidious arts of a woman and a rival; and his fall was haſtened by a raſh declaration, that his cap and ink horn, the badges of his office, were connected by the divine decree with the throne and diadem of the ſultan. At the age of 93 years, the venerable ſtateſman was diſmiſſed by his maſter, accuſed by his enemies, and murdered by a fanatic: the laſt words of Nizam atteſted his innocence, and the remainder of Malek's life was ſhort and inglorious.

NO, (Jeremiah, Ezekiel), NO-AMMON, (Nahum); a conſiderable city of Egypt, thought to be the name of an idol which agrees with Jupiter Ammon. The Septuagint tranſlate the name in Ezekiel, *Dioſpolis*, "the city of Jupiter." Bochart takes it to be *Thebes* of Egypt; which, according to Strabo and Ptolemy, was called *Dioſpolis*. Jerome, after the Chaldee paraphraſt Jonathan, ſuppoſes it to be Alexandria, named by way of anticipation; or an ancient city of that name is ſuppoſed to have ſtood on the ſpot where Alexandria was built.

No-Man's-Land, a ſpace between the after part of the belfrey and the fore part of a ſhip's boat, when the ſaid boat is ſtowed upon the booms, as in a deep waiſted veſſel. Theſe booms are laid from the forecaſtle nearly to the quarter-deck, where their after ends are uſually ſuſtained by a frame called the *gallows*, which conſiſts of two ſtrong poſts, about ſix feet high, with a croſs piece reaching from one to the other, athwart ſhips, and ſerving to ſupport the ends of thoſe booms, maſts, and yards, which lie in reſerve to ſupply the place of others carried away, &c. The ſpace called *No-Man's Land* is uſed to contain any blocks, ropes, tackles, &c. which may be neceſſary on the forecaſtle. It probably derives this name from its ſituation, as being neither on the ſtarboard nor larboard ſide of the ſhip, nor on the waſte or forecaſtle; but, being ſituated in the middle, partakes equally of all thoſe places.

NOAH, or NOE, the ſon of Lamech, was born in the year of the world 1056. Amidſt the general corruption into which all mankind were fallen at this time, Noah alone was found to be juſt and perfect in his generation, walking with God (Gen. vi. 9.). This extraordinary perſon having therefore found favour in the eyes of the Lord, and God ſeeing that all fleſh had corrupted their ways, told Noah, that he was reſolved to deſtroy mankind from the face of the earth, by a flood of waters; and not them alone, but all the beaſts of the earth, and every creeping thing, as well as the fowls of the air (*Id. ib.* 7.). The Lord therefore directed Noah, as a means of preſerving him and his family (for he had three ſons, Shem, Ham, and Japheth, who were all married before the flood), to build an ark or veſſel, of a certain form and ſize fitted to that end, and which might beſides accommodate ſuch numbers of animals of all ſorts, that were liable to periſh in the flood, as would be ſufficient to preſerve the ſeveral ſpecies, and again repleniſh the earth; together with all neceſſary proviſions for them; all which Noah performed, as may be ſeen more particularly under the article ARK.

In the year of the world 1656, and in the 600th year of his age, Noah, by God's appointment, entered the ark, together with his wife, his three ſons, their wives, and all the animals which God cauſed to come to Noah; and being all entered, and the door of the ark being ſhut upon the outſide, the waters of the deluge began to fall upon the earth, and increaſed in ſuch a manner, that they were fifteen cubits above the tops of the higheſt mountains, and continued thus upon the earth for 150 days; ſo that whatever had life upon the earth, or in the air, was deſtroyed, except ſuch as were with Noah in the ark. But the Lord remembering Noah, ſent a wind upon the earth, which cauſed the waters to ſubſide; ſo that upon the ſeventeenth day of the ſeventh month the ark reſted on the mountains of Ararat; and Noah having uncovered the roof of the ark, and obſerving the earth was dry, he received orders from the Lord to come out of it, with all the animals that were therein; and this he did in the ſix hundred and firſt year of his age, on the 27th day of the ſecond month. But the hiſtory of the deluge is more circumſtantially related already under the article DELUGE.

Then he offered as a burnt ſacrifice to the Lord one of all the pure animals that were in the ark; and the Lord accepted his ſacrifice, and ſaid to him, that he would no more pour out his curſe upon the whole earth, nor any more deſtroy all the animals as he had now done. He gave Noah power over all the brute creation, and permitted him to eat of them, as of the herbs and fruits of the earth; except only the blood, the uſe of which God did not allow them. He bid him increaſe and multiply, made a covenant with him, and God engaged himſelf to ſend no more an univerſal deluge upon the earth; and as a memorial of his promiſe, he ſet his bow in the clouds, to be as a pledge of the covenant he made with Noah (Gen. ix.).

Noah, being an huſbandman, began now to cultivate the vine; and having made wine and drank thereof, he unwarily made himſelf drunk, and fell aſleep in his tent, and happened to uncover himſelf in an indecent poſture. Ham, the father of Canaan, having obſerved him in this condition, made himſelf ſport with him, and acquainted his two brothers with it, who were without. But they, inſtead of making it a matter of ſport, turned away from it, and going backwards they covered their father's nakedneſs, by throwing a mantle over him. Noah awaking, and knowing what Ham had done, ſaid, that Canaan the ſon of Ham ſhould be accurſed, that he ſhould be a ſlave of ſlaves in reſpect of his brethren. It is thought he had a mind to ſpare the perſon of his ſon Ham, for fear the curſe might light upon

Noah.

upon the other children of Ham, who had no part in this action. He cursed Canaan by a spirit of prophecy, because the Canaanites his descendants were after this to be rooted out by the Israelites. Noah added, Let the Lord, the God of Shem, be blessed, and let Canaan be the servant of Shem. And he was so in effect, in the person of the Canaanites subdued by the Hebrews. Lastly, Noah said, Let God extend the possession of Japheth; let Japheth dwell in the tents of Shem, and let Canaan be his servant. This prophecy had its accomplishment, when the Grecians, and afterwards the Romans, being descended from Japheth, made a conquest of Asia, which was the portion of Shem.

But Noah lived yet after the deluge three hundred and fifty years; and the whole time of his life having been nine hundred and fifty years, he died in the year of the world 2006. He left three sons, Shem, Ham, and Japheth, of whom mention is made under their several names; and according to the common opinion, he divided the whole world amongst them, in order to repeople it. To Shem he gave Asia, to Ham Africa, and Europe to Japheth. Some will have it, that besides these three sons he had several others. The spurious Berosus gives him thirty, called Titans, from the name of their mother Titæa. They pretend that the Teutons or Germans are derived from a son of Noah called Thuiscon. The false Methodius also makes mention of Jonithus or Jonicus, a pretended son of Noah.

St Peter calls Noah a preacher of righteousness (2 Peter ii. 5.), because before the deluge he was incessantly preaching and declaring to men, not only by his discourses, but by his unblameable life, and by the building of the ark, in which he was employed six score years, that the wrath of God was ready to pour upon them. But his preaching had no effect, since, when the deluge came, it found mankind plunged in their former enormities (Mat. xxiv. 37.).

Several learned men have observed, that the Heathens confounded Saturn, Deucalion, Ogyges, the god Cœlus or Uranus, Janus, Proteus, Prometheus, &c. with Noah. The wife of Noah is called Noriah by the Gnostics; and the fable of Deucalion and his wife Pyrrha is manifestly invented from the history of Noah.

The Rabbins pretend, that God gave Noah and his sons (all who are not of the chosen race of Abraham they call Noachidæ) certain general precepts, which contain, according to them, the natural right which is common to all men indifferently, and the observation of which alone will be sufficient to save them. After the law of Moses, the Hebrews would not suffer any stranger to dwell in their country, unless he would conform to the precepts of the Noachidæ. In war they put to death, without quarter, all that were ignorant of them. These precepts are seven in number.

The *first* directs, that obedience be paid to judges, magistrates, and princes.

By the *second*, the worship of false gods, superstition, and sacrilege, are absolutely forbidden.

The *third* forbids cursing the name of God, blasphemies, and false oaths.

The *fourth* forbids all incestuous and unlawful conjunctions, as sodomy, bestiality, and crimes against nature.

Nob ‖ Nobility.

The *fifth* forbids the effusion of blood of all sorts of animals, murder, wounds, and mutilations.

The *sixth* forbids thefts, cheats, lying, &c.

The *seventh* forbids to eat the parts of an animal still alive, as was practised by some Pagans.

To these the Rabbins have added some others; but what inclines us to doubt the antiquity of these precepts is, that no mention is made of them in Scripture, or in the writings of Josephus or Philo; and that none of the ancient fathers knew any thing of them.

NOB, a sacerdotal city of the tribe of Benjamin or Ephraim. St Jerome says, that in his time it was entirely destroyed, and that the ruins of it might be seen not far from Diospolis. When David was driven away by Saul, he went to Nob, and asking the high priest Ahimelech for some provisions and arms, the priest gave him the shew bread which had been lately taken off the holy table, and the sword of Goliath. Saul being informed of this by Doeg, caused all the priests of Nob to be slain, and the city to be destroyed, 1 Sam. xxi. xxii.

NOBAH, a city beyond Jordan. It took the name of Nobah from an Israelite of this name who had made a conquest of it, (Numb. xxxii. 42.). Gideon pursued the Midianites as far as this city, (Judg. viii. 2.). Eusebius says, that there is a desolate place of this name about eight miles from Heshbon towards the south. But this could not be the Nobah now mentioned, because it was much farther to the north.

NOBILIARY, in literary history, a book containing the history of the noble families of a nation or province: such are Choricre's Nobiliary of Dauphiné, and Caumartin's Nobiliary of Provence. The Germans are said to be particularly careful of their Nobiliaries, in order to keep up the dignity of their families.

NOBILITY, in general, signifies dignity, grandeur, or greatness; more particularly, it signifies antiquity of family, joined with riches: in the common acceptation of the word, it means that quality or dignity which raises a man above the rank of a peasant or a commoner.

At a time when the public mind is so much agitated on this subject, or subjects nearly allied to it, perhaps the less that is said on it the better. We should therefore (as far as concerns the question about its expediency in civil life, or the contrary) most cheerfully pass it over in silence, did we not esteem it our duty to give our readers at least some idea of it, and were it not our business to lay before them a few of those arguments which of late have been so copiously retailed both for and against this illustrious order of civil society: leaving them, however, that liberty which every man unquestionably ought to be allowed of judging for themselves as they shall see most proper.

Whether that equality of rank and condition which has of late been so loudly contended for would be more agreeable to the order of nature, or more conducive to the happiness and prosperity of mankind, may indeed be made a question; but it is a question, we apprehend, which cannot receive different answers from men capable of reflecting without prejudice and partiality. A state of perfect equality can subsist only among

Nobility. among beings poſſeſſing equal talents and equal virtues; but ſuch beings are not men. Were all mankind under the conſtant influence of the laws of virtue, a diſtinction of ranks would be unneceſſary; but in that caſe civil government itſelf would likewiſe be unneceſſary, becauſe men would have attained all that perfection to which it is the object of civil government as well as of religion to guide them: every man then would be a law unto himſelf. But whilſt, in ſo many breaſts, the ſelfiſh paſſions predominate over thoſe which are ſocial, violence muſt be reſtrained by authority; and there can be no authority without a diſtinction of ranks, ſuch as may influence the public opinion.

It is well obſerved by Hume, that government is founded only on opinion; and that this opinion is of two kinds, opinion of intereſt, and opinion of right. When a people are perſuaded that it is their intereſt to ſupport the government under which they live, that government muſt be very ſtable. But among the worthleſs and unthinking part of the community, this perſuaſion has ſeldom place. All men, however, have a notion of rights—of a right to property and a right to power: and when the majority of a nation conſiders a certain order of men as having a right to that eminence in which they are placed, this opinion, call it prejudice or what we will, contributes much to the peace and happineſs of civil ſociety. There are many, however, who think otherwiſe, and imagine that "the ſociety in which the greateſt equality prevails muſt always be the moſt ſecure. Theſe men conceive it to be the buſineſs of a good government to diſtribute as equally as poſſible thoſe bleſſings which bounteous nature offers to all." It may readily be allowed that this reaſoning is concluſive; but the great queſtion returns, "How *far* can equality prevail in a ſociety which is ſecure? and what is *poſſible* to be done in the equal diſtribution of the bleſſings of nature?" Till theſe queſtions be anſwered, we gain nothing by declaiming on the rights and equality of men; and the anſwers which have ſometimes been given to them ſuppoſe a degree of perfection in human nature, which, if it were real, would make all civil inſtitutions uſeleſs, as well as the reveries of thoſe reformers. The conduct of the democratic ſtates of Pagan antiquity, together with the oppreſſive anarchy and ſhameful violences which we have ſeen and ſtill ſee in a neighbouring kingdom, will be conſidered by many as a full and ſatisfactory anſwer, deduced from experience, to all the ſchemes of the viſionary theoriſt: ſuch facts at leaſt render the abolition of the order of nobility a matter of more importance, and of infinitely greater difficulty, than thoſe who plead for it are diſpoſed to allow.

It is an opinion not uncommon, and at leaſt plauſible, that the nobility of a well regulated ſtate is the beſt ſecurity againſt monarchical deſpotiſm or lawleſs uſurpation on the one hand, and the confuſion of democratic inſolence on the other. Self intereſt is the moſt powerful principle in the human breaſt; and it is obviouſly the intereſt of ſuch men to preſerve that balance of power in ſociety upon which the very exiſtence of their order depends. Corrupted as the preſent age confeſſedly is, a very recent inſtance could be given, in which the Britiſh Houſe of Peers reſcued at once the ſovereign and the people from the threatened tyranny of a factious junto. As it is our buſineſs, however, to exhibit all opinions of any celebrity, we ſhall lay before our readers a ſhort extract from Dulaure's Critical Hiſtory of the French Nobility, which contains, in few but forcible words, ſome of the common arguments againſt this diſtinction of ranks. Nobility.

"Nobility (ſays he), a diſtinction equally impolitic and immoral, and worthy of the times of ignorance and of rapine, which gave it birth, is a violation of the rights of that part of the nation that is deprived of it; and as equality becomes a *ſtimulus* towards diſtinction, ſo on the other hand this is the radical vice of a government and the ſource of a variety of evils. It is almoſt impoſſible that there ſhould be any uncommon inſtances of virtue in a ſtate, when recompenſes belong excluſively to a certain claſs of ſociety, and when it coſts them no more to obtain theſe than the *trouble of being born*. Amongſt this liſt of privileged perſons, virtues, talents, and genius, muſt of courſe be much leſs frequent than in the other claſſes, ſince, without the poſſeſſion of any of theſe qualities, they who belong to it are ſtill honoured and rewarded. Thoſe who profit by this abſurd ſubverſion of principles, and thoſe who loſe by this unjuſt diſtribution of favours, which ſeem to have grown into a right, cannot have any other than falſe, immoral, and pernicious ideas concerning *merit*."

A perfect equality, however, in rank and fortune has ſeldom been contended for, except by the moſt ignorant enthuſiaſts. It is indeed doubtful whether it could poſſibly exiſt. The more moderate and rational reformers have acknowledged, that as theſe differences have always exiſted in ſome way or other, ſo, from the infinite variety of talents and attainments in the world, we have reaſon to expect they will exiſt in every form of government and among every people. The queſtion, therefore, is reduced to this: Whether the preſent mode of diſtinction, or any other which could be inſtituted in its ſtead, be upon the whole the beſt? That the preſent is not perfect, or wholly without faults, few will be ſanguine enough to contradict: and a wiſe man in the ſober hour of philoſophical reflection will ſcarce preſume to aſſert, that any other ſcheme which human ingenuity can plan would be wholly without imperfection, or altogether free from error. The caſe is, the errors of our own ſyſtem are preſent, and on this account we ſee and feel them with peculiar force: the other plan we look forward to perhaps in too ſanguine a manner, and we probably forget, in the deluſive heat of imagination, that if diſtinction depended entirely on merit, we ſhould ſcarce find a ſociety of men ſo honeſt, or ſo able, as always to reward it according to its deſerts; or if this were poſſible, as perhaps in the nature of things it is not, ſuch is the ſelf-partiality of the generality of men, that few would think he were dealt juſtly by if he were not promoted as well as his neighbour; and it is clearly impoſſible to promote every one. For ſuch reaſons then, and many more which our limits oblige us to omit, many think (and we are inclined to think with them), that it is ſafer to remain as we are, as we know the evils that attend our ſituation, and are ſtill able to bear them, rather than to hazard a change, which, Nobility.

which, with ſome benefits, might alſo perhaps increaſe the troubles, and deſtroy many of the pleaſures of ſocial life.

Perhaps it may not be amiſs to lay before our renders the following obſervations from that moſt judicious commentator on the laws of England, Mr Juſtice Blackſtone, on this important ſubject.

Blackſt. Comment.

"The diſtinction of rank and honours (ſays he) 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 peculiarly 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 17th 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."—Theſe remarks, at a time like the preſent, deſerve our ſerious attention; nor do we ſuppoſe our readers will be diſpleaſed, if we add the following obſervations on the ſubject from a periodical publication of long ſtanding and very conſiderable merit.

Gent. Mag. vol. xii.

"Birth and nobility are a ſtronger obligation to virtue than is laid upon meaner perſons. A vicious or diſhonourable nobleman is in effect perjured; for his honour is his oath.

"Under the patriarchal ſcheme, and at the firſt ſetting out of the tribes, the heads of families had their particular eſcutcheons, and their genealogies recorded with the utmoſt exactneſs: Even the Ancient of Days confirmed this; he often put his people in mind of the glory and virtues of their forefathers; and hath ſet a precedent for attainders, by viſiting the third and fourth generation.

Nobility.

"It is a vulgar error to ſuppoſe, that his bleſſed Son choſe his followers out of the meaneſt of the people, becauſe mechanics; for this was part of the education of every Jewiſh nobleman: Two of the number, being his kinſmen, were of the royal houſe of David; one was a Roman gentleman, and another of the royal family of Syria; and for the reſt, he had the ſame right of creation as his Father and his vicegerents, of advancing the poor to honour, and of exalting the lowly and meek.

"The ancient Greeks and Romans paid great regard to nobility; but when the levelling principle obtained, and the people ſhared power and honour, thoſe ſtates ſoon dwindled and came to ruin. And in preſent Rome, great reſpect is paid to the renowned families of Colonna and Cæſarini. In Venice, the notion of nobility is carried ſo high as to become inconſiſtent with a republican ſcheme. The Spaniards pay more regard to their old nobles than to their old Chriſtians; and the French are but little behind them. What was ſaid of the duke of Montmorency by Henry IV. "That he was a better gentleman than himſelf," was, perhaps, the reaſon why the laſt heir of ſo illuſtrious a family was cut off, to make the houſe of Bourbon the firſt in France.—The Welſh, Iriſh, and Polanders, are remarkable for their attachment to blood and pedigree.

"It is for the ſake of the meaneſt of our people, that the high value and regard for quality ſhould be kept up; for they are beſt governed by thoſe who ſeem formed for power: the robe of authority ſits eaſy upon them, and ſubmiſſion is as much our choice as our duty; but upſtarts prove the worſt of tyrants.

"The ancient legiſlators, who ſtudied human nature, thought it adviſable, for the better government of ſtates, that the people ſhould be divided into the noble and the common. They judged it for the univerſal good of mankind, that the valiant and the wiſe ſhould be ſeparated from the reſt, and appointed for council and command.

"To this I take it that the inſtitution of nobility is owing in all countries; even thoſe nations which we are pleaſed to call *ſavage*, diſtinguiſh the wiſe and the valiant, obey them as counſellors and commanders, which is placing them in the rank of nobles.

"Some, I know, look upon the inſtitution of nobility to be one of the groſſeſt impoſitions upon the common ſenſe of mankind; they confine it indeed to hereditary nobility; they allow, that thoſe who have done the commonwealth any ſignal ſervice ſhould be diſtinguiſhed with honours, but it ſeems an abſurdity to them that a man ſhould be born a legiſlator, as if wiſdom or a knowledge of government ran in the blood. But if they would conſider how ſtrong the love of poſterity is planted in human nature, they muſt allow that nothing can be a ſtronger motive to great and worthy actions, than the notion that a man's poſterity will reap the honour and profit of his labours.

Nobility. Besides, we are to suppose that men born to honours and a high fortune may be bred up in generous sentiments, and formed for the station they are to fill; that they must be strangers to those vicious falsehoods and corruptions which necessity first, and then habit, puts men upon practising, whose lives are spent in pursuit of their fortunes. I will own, notwithstanding all these advantages, that many of them are like rocks whose heads are in the clouds, but are so barren that they are quite incapable of producing any thing; but in general, were their minds only upon a level with those of other men, we should expect better fruit from them.

"As authority is founded in opinion, all wise commonwealths have been extremely jealous in keeping up the honour of their nobility. Wherever they become base, effeminate, cowardly, or servile, their authority sinks, they fall into contempt; then the people begin to consider them as useless to government, and look upon their privileges as a grievance to society, and perhaps they think how to get rid of them, as happened in the commonwealth of Florence, where, after the expulsion of the duke of Athens, a petty tyrant of that city, many of the nobility having behaved servilely to him, and insolently to the people, were degraded from the senate and the magistracy, and rendered incapable of holding any employment in the commonwealth.

"Father Paul, the Venetian, says, that you must either keep your nobility free from taint, or have no nobility at all: That the high employments of the commonwealth should be bestowed amongst the most ancient families, unless where a person should distinguish himself by some signal service to the state. Such a man would think himself sufficiently rewarded by the honour of being put upon a footing with the ancient nobility; and the nobility would be pleased to find that no commoner, except some of great reputation and merit, was to hold any of the employments usually possessed by their body. If the person so preferred should not be rich enough to support the dignity of the office, the state may give him a pension, but by no means should employments be made lucrative; which not only exhaust and weaken the commonwealth, but wherever the high employments are sought for profit, the nobility lose their generous sentiments, and it is a means of introducing corruption amongst them."

The origin of nobility in Europe is by some referred to the Goths; who, after they had seized a part of Europe, rewarded their captains with titles of honour, to distinguish them from the common people. We shall only in this place further consider the manner in which in our own country they may be created, and the incidents attending them; referring for a fuller account of their origin in Europe to the articles REVOLUTION, and *Civil* SOCIETY.

1. The right of peerage seems to have been originally territorial; that is, annexed to lands, honours, castles, manors, and the like; the proprietors and possessors of which were (in right of those estates) allowed to be peers of the realm, and were summoned to parliament to do suit and service to their sovereign: and, when the land was alienated, the dignity passed with it as appendant. Thus in England the bishops still sit in the house of lords in right of succession to certain ancient baronies annexed, or supposed to be annexed, to their episcopal lands; and thus in 11 Henry VI. the possession of the castle of Arundel was adjudged to confer an earldom on its possessor. But afterwards, when ALIENATIONS grew to be frequent, the dignity of peerage was confined to the lineage of the party ennobled, and instead of territorial became personal. Actual proof of a tenure by barony became no longer necessary to constitute a lord of parliament; but the record of the writ of summons to him or his ancestors was admitted as a sufficient evidence of the tenure.

Blackst. Comment. Peers of Great Britain are now created either by writ or by patent; for those who claim by prescription must suppose either a writ or patent made to their ancestors; though by length of time it is lost. The creation by writ or the king's letter is a summons to attend the house of peers, by the style and title of that barony which the king is pleased to confer: that by patent is a royal grant to a subject of any dignity and degree of peerage. The creation by writ is the more ancient way; but a man is not ennobled thereby, unless he actually take his seat in the house of lords; and some are of opinion that there must be at least two writs of summons, and a sitting in two distinct parliaments, to evidence a hereditary barony; and therefore the most usual, because the surest way, is to grant the dignity by patent, which endures to a man and his heirs according to the limitation thereof, though he never himself makes use of it. Yet it is frequent to call up the eldest son of a peer to the house of lords by writ of summons, in the name of his father's barony, because in that case there is no danger of his children's losing the nobility in case he never takes his seat; for they will succeed to their grandfather. Creation by writ has also one advantage over that by patent; for a person created by writ holds the dignity to him and his heirs, without any words to that purport in the writ; but in letters patent there must be words to direct the inheritance, else the dignity endures only to the grantee for life. For a man or woman may be created noble for their own lives, and the dignity not descend to their heirs at all, or descend only to some particular heirs: as where a peerage is limited to a man and the heirs male of his body by Elizabeth his present lady, and not to such heirs by any former or future wife.

2. Let us next take a view of a few of the principal incidents attending the nobility,—exclusive of their capacity as members of parliament, and as hereditary counsellors of the crown; for both which we refer to the articles LORDS and PARLIAMENT. And first we must observe, that in criminal cases a nobleman shall be tried by his peers. The great are always obnoxious to popular envy: were they to be judged by the people, they might be in danger from the prejudice of their judges; and would moreover be deprived of the privilege of the meanest subjects, that of being tried by their equals, which is secured to all the realm by magna charta, c. 29. It is said, that this does not extend to bishops, who, though they are lords of parliament, and sit there by virtue of their baronies which they hold *jure ecclesiæ*, yet are not ennobled in blood, and consequently not peers with the nobility. As to peeresses, no provision was made for their

their trial when accuſed of treaſon or felony, till after Eleanor ducheſs of Glouceſter, wife to the lord protector, had been accuſed of treaſon, and found guilty of witchcraft, in an eccleſiaſtical ſynod, through the intrigues of Cardinal Beaufort. This very extraordinary trial gave occaſion to a ſpecial ſtatute, 20 Hen. VI. c. 9. which enacts, that peereſſes, either in their own right or by marriage, ſhall be tried before the ſame judicature as peers of the realm. If a woman, noble in her own right, marries a commoner, ſhe ſtill remains noble, and ſhall be tried by her peers: but if ſhe be only noble by marriage, then by a ſecond marriage with a commoner ſhe loſes her dignity; for as by marriage it is gained, by marriage it is alſo loſt. Yet if a ducheſs dowager marries a baron, ſhe continues a ducheſs ſtill: for all the nobility are *pares*, and therefore it is no degradation. A peer or peereſs (either in her own right or by marriage) cannot be arreſted in civil caſes: and they have alſo many peculiar privileges annexed to their peerage in the courſe of judicial proceedings. A peer ſitting in judgement, gives not his verdict upon oath, like an ordinary juryman, but upon his honour; he anſwers alſo to bills in chancery upon his honour, and not upon his oath: but, when he is examined as a witneſs either in civil or criminal caſes, he muſt be ſworn; for the reſpect which the law ſhows to the honour of a peer does not extend ſo far as to overturn a ſettled maxim, that *in judicio non creditur niſi juratus*. The honour of peers is however ſo highly tendered by the law, that it is much more penal to ſpread falſe reports of them, and certain other great officers of the realm, than of other men: ſcandal againſt them being called by the peculiar name of *ſcandalum magnatum*, and ſubjected to peculiar puniſhment by divers ancient ſtatutes.

A peer cannot loſe his nobility but by death or attainder; though there was an inſtance, in the reign of Edward IV. of the degradation of George Nevile duke of Bedford by act of parliament, on account of his poverty, which rendered him unable to ſupport his dignity. But this is a ſingular inſtance, which ſerves at the ſame time, by having happened, to ſhow the power of parliament; and, by having happened but once, to ſhow how tender the parliament hath been in exerting ſo high a power. It hath been ſaid indeed, that if a baron waſtes his eſtate, ſo that he is not able to ſupport the degree, the king may degrade him: but it is expreſsly held by later authorities, that a peer cannot be degraded but by act of parliament.

Anton. Matthæus obſerves, that nobility, among the Romans, was a quite different thing from what it is among us. The nobles, among the Romans, were either thoſe raiſed to the magiſtrature, or deſcended from magiſtrates: there was no ſuch thing as nobility by patent.

Bartoli ſays, that doctors, after they have held a profeſſor's chair in an univerſity for 20 years, become noble; and are entitled to all the rights of counts.

But this claim is not admitted at court, &c. though Bartoli's ſentiments be backed with thoſe of ſeveral other authors, particularly Chaſſanæus in his *Conſuetudin. Burgundiæ*; *Boyer ſur la Coutume de Berry*; *Faber C. de Dig. Def.* 9. &c. which laſt, however, reſtrains Bartoli's rule to doctors in law, and princes phyſicians.

By an edict of the French king in 1669, it is declared, that trade ſhall not derogate from nobility, provided the perſon do not ſell by retail.

In Bretagne, by ancient cuſtom, a nobleman loſes nothing by trading even in retail; but he reaſſumes all his rights as ſoon as he ceaſes traffic, his nobility having ſlept all the time.

In Germany, a woman, not noble by birth, doth not become, *v. gr.* a counteſs or baroneſs by marrying a count or baron: a lady of the higher degree indeed becomes a princeſs by marrying a prince; but this does not hold of a lady of the lower nobility.

On the coaſt of Malabar, children are only capable of being noble by the mother's ſide; it being allowed them to take as many huſbands as they pleaſe, and to quit them whenever they think proper.

NOBLE, *Nobilis*, a perſon who has a privilege which raiſes him above a commoner or peaſant, either by birth, by office, or by patent from his prince. The word comes from the Latin *nobilis*; formed from the ancient *noſcibilis*, "diſtinguiſhable, remarkable."

In England, the word *noble* is of a narrower import than in other countries, being confined to perſons above the degree of knights; whereas, abroad, it comprehends not only knights, but what we ſimply call *gentlemen*. The nobles of England are alſo called *pares regni*, as being *nobilitatis pares*, though *gradu impares*.

The Venetian *nobleſſe* is famous: it is in this that the ſovereignty of the ſtate reſides. It is divided into three claſſes. The firſt only comprehends 24 families. The ſecond includes the deſcendants of all thoſe who were entered in the Golden Book, in 1289, and deſtined to govern the ſtate, which then began to be ariſtocratic. The third conſiſts of ſuch as have bought the dignity of noble Venetians. This laſt claſs is only admitted to the inferior employs; the two former to all indifferently. The title of *noble Venetians* is ſometimes alſo given to foreign kings, princes, &c.

NOBLES, among the Romans, were ſuch as had the *jus imaginum*, or the right of uſing the pictures or ſtatues of their anceſtors; a right which was allowed only to thoſe whoſe anceſtors had borne ſome *curule* office, that is, had been *curule ædile*, *cenſor*, *prætor*, or *conſul*. For a long time, none but the *patricii* were the *nobiles*, becauſe no perſon but of that ſuperior rank could bear any *curule* office; hence in Livy, Salluſt, &c. *nobilitas* is uſed to ſignify the patrician order, and ſo oppoſed to *plebs*. To make the true meaning of *nobiles* ſtill more clear, let it be obſerved, that the Roman people were divided into *nobiles*, *novi*, and *ignobiles*. *Nobiles* were they who had the pictures, &c. of their anceſtors; *novi* were ſuch as had only their own; *ignobiles* were ſuch as had neither. See *JUS Imaginis*.

The Roman nobility, by way of diſtinction, wore a half moon upon their ſhoes, eſpecially thoſe of patrician rank.

The Grecian nobility were called Ευπατρίδαι, as being deſcended from thoſe old heroic anceſtors ſo famous in hiſtory. Such were the *Praxiergidæ*, *Etrobutidæ*, *Alcmæonidæ*, &c. all which had many privileges annexed to their quality; amongſt which was this, that they wore graſhoppers in their hair as a badge of nobility.

NOBLE, a money of account containing ſix ſhillings and eight pence.

The noble was anciently a real coin ſtruck in the reign of Edward III. and then called the *penny of gold*; but

Nocera || Noctambuli.

but it was afterwards called a *rose-noble*, from its being stamped with a rose: it was current at 6s. 8d.

NOCERA, a town in Italy, in the dominions of the king of Naples and Sicily, or, as he is more commonly called, the king of the Two Sicilies. It is an episcopal city, but might with greater propriety be styled a cluster of villages; its several parts being extended along the foot of the mountains, form the Cittá Sotana, or low town; and the bishop's palace, together with some convents embowered in cypress groves, cover the peak of a single hill in a very picturesque manner, and compose the Cittá Soprana.

Nocera (A), it is reported, contains near 30,000 inhabitants; they are dispersed in forty patches of habitation. Their houses are constructed of two kinds of stone: the common walls are built with yellow tufa dug out of the hills that lie about a mile to the east of the town; which stone seems unquestionably to have been formed by a consolidation of substances thrown out of Vesuvius, because, on opening these quarries, the workmen have frequently discovered tombs, vases, and coins locked up in the body of the stony stratum. The cases of their doors and windows are made of a black stone drawn from the hill of Fiano, two miles to the north: it lies eight feet below the surface, in a bed or vein 140 feet thick, resting upon a base of sand. This seems evidently to be a stream of lava congealed.

Nocera is a place of very considerable antiquity: in the 13th century it was called de Pagani, to distinguish it from a city in Umbria of a similar name; this addition was in allusion to a colony of Saracens which Frederick of Suabia brought from Sicily, and settled here, that they might be out of the way of their dangerous connexions with Africa: hence Nocera has often been confounded with Lucera by the negligent or ignorant chroniclers of the succeeding ages. The most remarkable event that occurs in its history is the siege of its castle, A. D. 1384. E. Long. 12. 49. N. Lat. 43. 1.

Terra NOCERIANA, *Earth of Nocera*, in the *Materia Medica*, a species of bole, remarkably heavy, of a grayish-white colour, of an insipid taste, and generally with some particles in it which grit between the teeth. It is much esteemed by the Italians as a remedy for venomous bites, and in fevers; but, excepting as an absorbent and astringent, no dependence is to be had on it.

NOCTAMBULI, NOCTAMBULONES, or *Night-walkers*; a term of equal import with *somnambuli*, applied to persons who have a habit of rising and walking about in their sleep. The word is a compound of the Latin *nox*, "night," and *ambulo*, "I walk."

Schenkius, Horstius, Clauderus, and Hildanus, who have written of sleep, give us divers unhappy histories of such noctambuli. When the disease is moderate, the persons affected with it only repeat the actions of the day on getting out of bed, and go quietly to the places they frequented at other times; but those who have it in the most violent degree, go up to dangerous places, and do things which would terrify them to think of when they are awake. These are by some called *lunatic* night-walkers, because fits are observed to return with the most frequency and violence at the changes of the moon.—For the cure some recommend purging and a cooling regimen: others are of opinion that the best method is to place a vessel of water at the patient's bedside in such a manner that he will naturally step into it when he gets out of bed; or if that should fail, a person should sit up to watch and beat him every time it happens. See SLEEP-WALKERS, or SOMNAMBULI.

Noctiluca, Nocturnal.

NOCTILUCA, a species of phosphorus, so called because it shines in the dark without any light being thrown upon it.

NOCTURNAL, something relating to the night, in contradistinction to diurnal.

NOCTURNAL, *Nocturlabium*, an instrument chiefly used at sea, to take the altitude or depression of some stars about the pole, in order to find the latitude and hour of the night.

Some nocturnals are hemispheres, or planispheres, on the plane of the equinoctial. Those commonly in use among seamen are two; the one adapted to the polar star, and the first of the guards of the Little Bear; the other to the pole star, and the pointers of the Great Bear.

This instrument consists of two circular plates, applied to each other. The greater, which has a handle to hold the instrument, is about $2\frac{1}{2}$ inches diameter, and is divided into twelve parts, agreeing to the twelve months; and each month subdivided into every fifth day; and so as that the middle of the handle corresponds to that day of the year wherein the star here regarded has the same right ascension with the sun. If the instrument be fitted for two stars, the handle is made moveable. The upper left circle is divided into twenty-four equal parts for the twenty-fours of the day, and each hour subdivided into quarters. These twenty-four hours are noted by twenty-four teeth to be told in the night. Those at the hour 12 are distinguished by their length. In the centre of the two circular plates is adjusted a long index, moveable upon the upper plate; Plate CCCLXX.
and the three pieces, viz. the two circles and index, are joined by a rivet which is pierced through the centre with a hole, through which the star is to be observed.

To use the nocturnal, turn the upper plate till the long tooth, marked 12, be against the day of the month on the under plate; then, bringing the instrument near the eye, suspend it by the handle with the plane nearly parallel to the equinoctial, and viewing the pole star through the hole of the centre, turn the index about, till, by the edge coming from the centre, you see the bright star or guard of the Little Bear, (if the instrument be fitted to that star): then that tooth of the upper circle, under the edge of the index, is at the hour of the night on the edge of the hour circle, which may be known without a light, by counting the teeth from the longest, which is for the hour 12.

NOD,

(A) Anciently, Nuceria Alphaterna, a word of unknown etymology. It was a Roman colony, and had its mint. Num. Nucerin.
1. Caput virile imberbe—Equus stans capite reflexo inter crura. A . . IN . .

NOD, or the *Land of* NOD. It was to this country that Cain withdrew after his fratricide, (Gen. iv. 16.). The Septuagint, as well as Josephus, read *Naid* instead of *Nod*, and have taken it for the name of a place. It is not easily known what country this was, unless perhaps it was the country of Nyse or Nysea, towards Hyrcania. St Jerome and the Chaldee interpreters have taken the word Nod in the sense of an appellative, for *vagabond* or *fugitive;* "He dwelt a fugitive in the land." But the Hebrew reads, "He dwelt in the land of Nod" (Gen. iv. 16.).

NODAB, a country bordering upon Iturea and Idumæa, but now unknown. We read in the Chronicles, that the tribe of Reuben, assisted by those of Gad and Manasseh, had a war against the Hagarites, the Jeturites, and the people of Nephish, and of Nodab, in which the Israelites had the advantage (1 Chr. v. 19.). But the time and the other particulars of this war are unknown.

NODATED HYPERBOLA, a name given by Sir Isaac Newton to a kind of hyperbola, which, by turning round, decussates or crosses itself.

NODDY. See STERNA, ORNITHOLOGY *Index*.

NODE, a tumour arising on the bones, and usually proceeding from some venereal cause; being much the same with what is otherwise called *exostosis*.

NODES, in *Astronomy*, the two points where the orbit of a planet intersects the ecliptic.

Plate CCCLXX. fig. 1.

Such are the two points C and D, fig. 1. of which the node C, where the planet ascends northward above the plane of the ecliptic, is called the *ascending node*, or the *dragon's head*, and is marked thus ☊. The other node D, where the planet descends to the south, is called the *descending node*, or the *dragon's tail*, marked thus ☋.

The line CD, wherein the two circles CEDF and CGDH intersect, is called the *line of nodes*. It appears from observation, that the line of the nodes of all the planets constantly changes its place, and shifts its situation from east to west, contrary to the order of the signs; and that the line of the moon's nodes, by a retrograde motion, finishes its circulation in the compass of 19 years; after which time, either of the nodes having receded from any point of the ecliptic, returns to the same again; and when the moon is in the node, she is also seen in the ecliptic. If the line of nodes were immoveable, that is, if it had no other motion than that whereby it is carried round the sun, it would always look to the same point of the ecliptic, or would keep parallel to itself, as the axis of the earth does.

From what hath been said, it is evident, that the moon can never be observed precisely in the ecliptic, but twice in every period; that is, when she enters the nodes. When she is at her greatest distance from the nodes, viz. in the points E, F, she is said to be in her limits.

The moon must be in or near one of the nodes, when there is an eclipse of the sun or moon.

To make the foregoing account of the motion of the moon's nodes still clearer, let the plane of fig. 2. represent that of the ecliptic, S the sun, T the centre of the earth, L the moon in her orbit DN*dn*. N*n* is the line of the nodes passing between the quadrature Q and the moon's place L, in her last quarter. Let now LP, or any part LS, represent the excess of the sun's action at T; and this being resolved into the force LR, perpendicular to the plane of the moon's orbit, and PR parallel to it, it is the former only that has any effect to alter the position of the orbit, and in this it is wholly exerted. Its effect is twofold: 1. It diminishes its inclination by a motion which we may conceive as performed round the diameter D*d*, to which LT is perpendicular. 2. Being compounded with the moon's tangential motion at L, it gives it an intermediate direction L*t*, through which and the centre a plane being drawn, must meet the ecliptic nearer the conjunction C than before.

NODUS, or NODE, in *Dialling*, a certain point or pole in the gnomon of a dial, by the shadow or light whereof either the hour of the day in dials without furniture, or the parallels of the sun's declination, and his place in the ecliptic, &c. in dials with furniture are shown. See DIALLING.

NOEOMAGUS LEXUVIORUM, (Ptol.); thought to be the *Civitas Lexoviorum* of the lower age. Now *Lisieux*, a city in Normandy.—Another of the *Tricastini;* a town of Gallia Narbonensis; thought be *S. Pol. de Trois Châteaux*, six miles to the west of Nyons in Dauphiné.

NOETIANS, in church history, Christian heretics in the third century, followers of Noetius, a philosopher of Ephesus, who pretended that he was another Moses sent by God, and that his brother was a new Aaron. His heresy consisted in affirming that there was but one person in the Godhead; and that the Word and the Holy Spirit were but external denominations given to God in consequence of different operations: that, as Creator, he is called *Father;* as Incarnate, *Son;* and as descending on the apostles, *Holy Ghost*.

NOLA, a very ancient city, formerly populous and strong, situated in a plain to the north-east of Vesuvius, in Campania, said to be built by the Chalcidians; (Justin, Silius Italicus); according to others, by the Tuscans. At this place Hannibal met with the first check by Marcellus. Vespasian added the appellation *Augusta Colonia*, (Frontinus). At this place, or in its neighbourhood, Augustus is said to have expired. It is also said that bells were first invented there in the beginning of the 5th century; hence their Latin names *Nolæ* or *Campanæ*. It retains its old name to this day, but it hath vastly fallen short of its ancient splendour. A town of the kingdom of Naples. E. Long. 15. N. Lat. 41. 5.

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

NOLLE PROSEQUI, is where a plaintiff in an action does not declare in a reasonable time; in which case it is usual for the defendant's attorney to enter a rule for the plaintiff to declare, after which a *non pros*. may be entered. A *nolle prosequi* is esteemed a voluntary confession, that the plaintiff has no cause of action; and therefore if a plaintiff enters his *nolle prosequi*, he shall be amerced; and if an informer cause the same to be entered, the defendant shall have costs.

NOLLET, JEAN ANTOINE, a deacon, licentiate in theology, preceptor to the *Enfans de France* for physics and natural history, regius professor of physics in the college of Navarre, member of the Academy of Sciences

Nollet. Sciences at Paris, of the Royal Society of London, of the Institution of Bologna, and of the Academy of Sciences of Erfort; was born at Pimbré, in the diocese of Noyon, on the 17th of November 1700, of respectable but not wealthy parents. To make up the want of riches, they determined to give their son a good education. They sent him to the college of Clermont in Beauvoisis, and afterwards to Beauvais, there to finish his introductory studies. The progress which he made in the different classes, determined them to send him to study philosophy at Paris. Thenceforward they intended him for the clerical order; and they considered the strictness and purity of his morals, together with his unwearied application to study, as sufficient proofs of his vocation. The young Nollet yielded without reluctance to the wishes of his parents. As soon as he was capable of showing an inclination for any thing, he had discovered a taste for physics; but this was not become his ruling passion; he therefore sacrificed it to the study of scholastic divinity, to which he wholly dedicated himself during his time of probation in 1728. No sooner had he been invested with the deaconship, than he solicited and obtained a license to preach. This new occupation, however, did not make him entirely lose sight of those studies which had first engaged his attention. They insensibly began to occupy a greater portion of his time, which was now more equally divided between theology and the sciences. The latter, however, prevailed; and thenceforth he entered into the study of physics with an ardour which was only increased by that kind of privation to which he had been long subject. He was received into the Society of Arts, established at Paris under the patronage of the late count de Clermont. In 1730, the abbé Nollet was engaged in a work conjunctly with Reaumur and du Fay of the Academy of Sciences. In 1734, he went to London in company with M. M. du Fay, du Hamel, and de Jussieu. His merit procured him a place in the Royal Society without any solicitation. Two years after, he went to Holland, where he formed an intimate connection with Desaguliers, Gravesande, and Muschenbroeck. On his return to Paris, he resumed the course of experimental physics which he had begun in 1735, and which he continued till 1760. These courses of physics first suggested the idea of particular courses in other branches of science, such as in chemistry, anatomy, natural history, &c. In 1738, the count de Maurepas prevailed on the cardinal Fleury to establish a public class for experimental physics; and the abbé Nollet was appointed the first professor. In the beginning of the year 1739, he was admitted a member of the Royal Academy of Sciences; and in the month of April following, the king of Sardinia intending to establish a professorship of physics at Turin, invited the abbé Nollet into his dominions. From thence he travelled into Italy. In 1744, he was honoured with an invitation to Versailles, to instruct the dauphin in experimental philosophy; the king and royal family were often present at his lectures. The qualities as well of his understanding as of his heart gained him the esteem and confidence of his pupil. Going one day in state to Paris, he caused intimation to be made that he was to dine at the Thuilleries. M. Nollet having gone thither to pay his court, the dauphin no sooner perceived him, than he had the goodness to say, "Binet has the advantage of me, he has been at your house." Till the period of his death, this prince showed marks of the strongest attachment and favour for this ingenious philosopher. He would have wished that he had been a little more attentive to the improvement of his fortune. He prevailed upon him to go and pay court to a man in power, whose patronage might have been of service to him. The abbé Nollet accordingly waited upon the placeman, and made him a present of his works. "I never read any works of that kind," said the patron coldly, and casting a look at the volumes before him. "Sir (replied the abbé), will you allow them to remain in your antichamber? There perhaps there may be found men of genius who will read them with pleasure." In the month of April 1749, he made a grand tour into Italy, being sent thither for the purpose of making observations. At Turin, Venice, and Bologna, the abbé Nollet appeared as a deputy from the philosophers of the rest of Europe. During his short stay in Italy, the wonders of electricity were not the only object of his researches; every part of physics, the arts, agriculture, &c. came equally under his notice. Upon his return through Turin, the king of Sardinia, always truly sensible of his merit, offered him the order of Saint Maurice, which he did not think proper to accept without his sovereign's permission. In 1753 the king instituted a class of experimental philosophy in the royal college of Navarre, and appointed the abbé Nollet professor. In 1757, he received from the king a brevet appointing him preceptor in physics and natural history to the *Enfans de France*. In the month of August, the same year, he was appointed professor of experimental philosophy in the school of artillery, at that time established at la Fere. In the month of November following, he was admitted as a pensionary of the Royal Academy of Sciences. M. de Cremillo, director general of artillery and fortification, having founded a class of experimental philosophy at Mezieres in 1761, the abbé Nollet was appointed professor. This celebrated and laborious philosopher, who has rendered the most important services to physics by the discoveries with which he has enriched every branch of this science, but particularly electricity, died at Paris on the 25th of April 1770, aged 70; much regretted by the literary world, and by his friends, of whom his gentle character and beneficent heart had procured him a great number. He often retired from the gay and splendid societies of Paris, to give assistance to his relations, who were by no means in affluent circumstances. His works are, 1. Several papers inserted in the memoirs of the Academy of Sciences; among which one on the Hearing of Fishes is particularly valuable. 2. *Leçons de Physique Experimentale*, 6 vols. 12mo; a book well composed, and uniting pleasure with instruction. 3. *Recueil de Lettres sur l'Electricité*, 3 vols 12mo, 1753. 4. *Essai sur l'Electricité des corps*, 1 vol. 12mo. 5. *Recherches sur les causes particulieres des Phenoménes Electriques*, 1 vol. 12mo. 6. *L'Andes experiences*, 3 vols 12mo, with figures, 1770.

Nomades. NOMADES, a name given, in antiquity, to several nations, whose whole occupation was to feed and tend their flocks; and who had no fixed place of abode, but were constantly shifting, according to the conveniences of pasturage.—The word comes from the Greek νεμω, *pasco*, "I feed."

The

The most celebrated among the Nomades were those of Africa, who inhabited between Africa properly so called, to the east, and Mauritania to the west. They are also called *Numidæ* or *Numidians*.—Sallust says, they were a colony of Persians brought into Africa with Hercules.

The Nomades of Asia inhabited the coasts of the Caspian sea. The Nomades of Scythia were the inhabitants of Little Tartary; who still retain the ancient manner of living.

NOMARCHA, in antiquity, the governor or commander of a nome or nomos.—Egypt was anciently divided into several regions or quarters, called *nomes*, from the Greek νομος, taken in the sense of a division; and the officer who had the administration of each *nome* or *nomos*, from the king, was called *nomarcha*, from νομος and αρχη, "command."

NOMBRE-DE-DIOS, a town of Mexico, in the province of Darien, a little to the eastward of Porto-Bello. It was formerly a famous place; but it is now abandoned, on account of its unhealthy situation. W. Long. 78. 35. N. Lat. 9. 43.

NOMBRIL POINT, in *Heraldry*, is the next below the fess point, or the very centre of the escutcheon.

Supposing the escutcheon divided into two equal parts below the fess, the first of these divisions is the nombril, and the lower the base.

NOME, or NAME, in *Algebra*, denotes any quantity with a sign prefixed or added to it, whereby it is connected with some other quantity, upon which the whole becomes a binomial, trinomial, or the like. See ALGEBRA.

NOMENCLATOR, in Roman antiquity, was usually a slave who attended upon persons that stood candidates for offices, and prompted or suggested to them the names of all the citizens they met, that they might court them and call them by their names, which among that people was the highest piece of civility.

NOMENCLATORS, among botanical authors, are those who have employed their labours about settling and adjusting the right names, synonymes, and etymologies of names, in regard to the whole vegetable world.

NOMENCLATURE, NOMENCLATURA, a catalogue of several of the more usual words in any language, with their significations, compiled in order to facilitate the use of such words to those who are to learn the tongue: such are our Latin, Greek, French, &c. nomenclatures: Or a system of technical language by which the objects of any science are denoted, as, for instance, the present language of chemical science, usually called the *new chemical nomenclature*, from its recent construction.

NOMENEY, a town in Germany, in the duchy of Lorrain, situated on the river Seille, 15 miles north of Nancy.

NOMINALS, or NOMINALISTS, a sect of school philosophers, the disciples and followers of Occam, or Ocham, an English Cordelier, in the 14th century. They were great dealers in words, whence they were vulgarly denominated *Word-sellers;* but had the denomination of *Nominalists*, because, in opposition to the *Realists*, they maintained, that words, and not things, were the object of dialectics.

This sect had its first rise towards the end of the 11th century, and pretended to follow Porphyry and Aristotle; but it was not till Ocham's time that they bore the name. The chief of this sect, in the 11th century, was a person called *John*, who, on account of his logical subtility, was called the *sophist;* and his principal disciples were Robert of Paris, Roscelin of Compiegne, and Arnoul of Laon. At the beginning, the Nominals had the upper hand: but the Realists, though greatly divided among themselves, were supported by men of great abilities; such as Albertus Magnus, T. Aquinas, and Duns Scotus. The nominal sect came hereby into disrepute; till William Occam, in the 14th century, again revived it, and filled France and Germany with the flame of disputation. Having joined the party of the Franciscan monks, who strenuously opposed John XXII. that pope himself, and his successors after him, left no means untried to extirpate the philosophy of the Nominalists, which was deemed highly prejudicial to the interests of the church: and hence it was, that, in the year 1339, the university of Paris, by a public edict, solemnly condemned and prohibited the philosophy of Occam, which was that of the Nominalists. The consequence was, that the Nominalists flourished more than ever. In the 15th century, the controversy was continued with more vigour and animosity than before; and the disputants were not content with using merely the force of eloquence, but had frequently recourse to more hostile and dangerous weapons; and battles were the consequence of a philosophical question, which neither side understood. In most places, however, the Realists maintained a manifest superiority over the Nominalists. While the famous Gerson, and the most eminent of his disciples were living, the Nominalists were in high esteem and credit in the university of Paris. But upon the death of these patrons, the face of things was much changed to their disadvantage. In the year 1473, Louis XI. by the instigation of his confessor, the bishop of Avranches, issued out a severe edict against the doctrines of the Nominalists, and ordered all their writings to be seized and secured, that they might not be read by the people: but the same monarch mitigated this edict the year following, and permitted some of the books of that sect to be delivered from their confinement. In the year 1481, he not only granted a full liberty to the Nominalists and their writings, but also restored that philosophical sect to its former authority and lustre in the university.

The Nominalists were the founders of the university of Leipsic: and there are many yet abroad who pique themselves on being Nominals.

The Nominals, with the Stoics, admit the formal conceptions or ideas of things, as the subject and foundation of universality: but to this they add names, which represent and signify, after the same univocal manner, and without any distinction, a great variety of single things alike in genus and species.

Whence it is that they are called *Nominals;* as pretending, that to become learned, it is not enough to have just ideas of things, but it is likewise required to know the proper names of the genera and species of things, and to be able to express them clearly and precisely, without confusion or ambiguity.

NOMINATIVE, in *Grammar*, the first CASE of NOUNS which are declinable.

The simple position, or laying down of a noun, or name, Nona || Nonagon.

name, is called the *nominative case;* yet it is not so properly a case, as the matter or ground whence the other cases are to be formed, by the several changes and inflections given to this first termination. Its chief use is to be placed in discourse before all verbs, as the subject of the proposition or affirmation.

NONA, a city of Dalmatia, remarkable at present only for its ruins, which might furnish abundant materials to gratify the curiosity of antiquaries; but indeed they are so buried by repeated devastations, to which that unhappy city has been exposed, that rarely any vestige of them appears above ground. "I went thither (says Fortis in his Travels), in hopes of finding something worthy of notice, but was disappointed. Nothing is to be seen that indicates the grandeur of the Roman times; neither are there any remains of barbarous magnificence, to put one in mind of the ages in which the kings of the Croat Slavi had their residence there. It lies on a small island, surrounded by a harbour, which in former times was capable of receiving large ships; but is now become a fetid pool by means of a little muddy river that falls into it, after a course of about six miles through the rich abandoned fields of that district. The ancient inhabitants turned this water into another channel, and made it run through the valley of Drasnich into the sea; and the remains of the bank raised by them for that purpose are still to be seen. Notwithstanding, however, the depopulation of this district, and the dreary situation of Nona in particular, the new inhabitants have not lost courage; and animated by the privileges granted to them by the most serene republic, are endeavouring to bring the population and agriculture once more into a flourishing state. Proper drains for the water would not only render that rich territory habitable, but moreover very fertile; and the brackish marsh that surrounds the walls of Nona is well calculated to supply a considerable quantity of fish, especially eels. The government generously granted the investiture to private persons, who already draw no inconsiderable advantage from the fishing; and did they but adopt better methods, they might every year salt many thousands of eels, which would greatly answer our internal commerce, and save at least a part of the money that goes out of the country for foreign salt fish. To the left of the city of Nona, the walls of some ancient ruinous buildings appear; which probably in ancient times were situated on the main land, though now surrounded by water. The sea forms a narrow channel in this place, which is easily fordable, and, at low water, the smallest boat can scarcely pass."

NONAGE, in *Law*, generally signifies all the time a person continues under the age of 21; but in a special sense, it is all the time that a person is under the age of 14.

NONAGESIMAL, or *NONAGESIMAL Degree*, called also the *Mid Heaven*, is the highest point, or 90th degree of the ecliptic, reckoned from its intersection with the horizon at any time; and its altitude is equal to the angle which the ecliptic makes with the horizon at their intersection, or equal to the distance of the zenith from the pole of the ecliptic. It is much used in the calculation of solar eclipses.

NONAGON, a figure having nine sides and angles. In a regular nonagon, or that whose angles and sides are all equal, if each side be 1, its area will be $6.1818242 = \frac{9}{4}$ of the tangent of 70°, to the radius 1.

Non, Nonconformists.

NON, Cape, a promontory on the west coast of Africa, opposite to the Canary islands. W. Long. 12. 0. N. Lat. 44. 28.

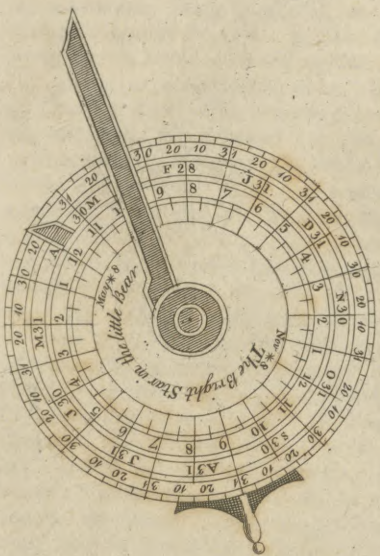
NONCONFORMISTS, those who refuse to join the established worship.

Nonconformists, in England, are of two sorts. First, Such as absent themselves from divine worship in the established church through total irreligion, and attend the service of no other persuasion. These, by the statute 1 Eliz. c. 2. 23 Eliz. c. 1. and 3 Jac. I. c. 4. forfeit one shilling to the poor every Lord's day they so absent themselves, and 20l. to the king if they continue such default for a month together. And if they keep any inmate thus irreligiously disposed in their houses, they forfeit 10l. per month.

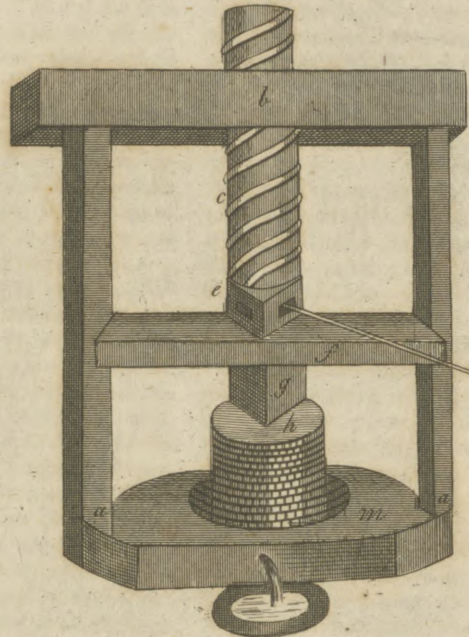
The second species of nonconformists are those who offend through a mistaken or perverse zeal. Such were esteemed, by the English laws enacted since the time of the Reformation, to be Papists and Protestant dissenters: both of which were supposed to be equally schismatics, in not communicating with the national church; with this difference, that the Papists divided from it upon material, though erroneous, reasons; but many of the dissenters upon matters of indifference, or, in other words, for no reason at all. "Yet certainly (says Sir William Blackstone) our ancestors were mistaken in their plans of compulsion and intolerance. The sin of schism, as such, is by no means the object of temporal coercion and punishment. If, through weakness of intellect, through misdirected piety, through perverseness and acerbity of temper, or (which is often the case) through a prospect of secular advantage in herding with a party, men quarrel with the ecclesiastical establishment, the civil magistrate has nothing to do with it; unless their tenets and practice are such as threaten ruin or disturbance to the state. He is bound indeed to protect the established church: and if this can be better effected by admitting none but its genuine members to offices of trust and emolument, he is certainly at liberty so to do; the disposal of offices being matter of favour and discretion. But this point being once secured, all persecution for diversity of opinions, however ridiculous or absurd they may be, is contrary to every principle of sound policy and civil freedom. The names and subordination of the clergy, the posture of devotion, the materials and colour of the minister's garment, the joining in a known or unknown form of prayer, and other matters of the same kind, must be left to the option of every man's private judgement. *Blackst. Comment.*

"With regard therefore to *Protestant dissenters*, although the experience of their turbulent disposition in former times occasioned several disabilities and restrictions (which I shall not undertake to justify) to be laid upon them by abundance of statutes; yet at length the legislature, with a true spirit of magnanimity, extended that indulgence to these sectaries, which they themselves, when in power, had held to be countenancing schism, and denied to the church of England. The penalties are conditionally suspended by the statute 1 W. & M. st. 1. c. 18. "for exempting their majesties Protestant subjects, dissenting from the church of England, from the penalties of certain laws," commonly called

NOCTURNAL.



OLIVE PRESS.



NODES.

Fig. 1

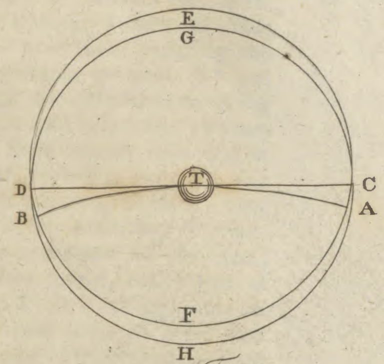
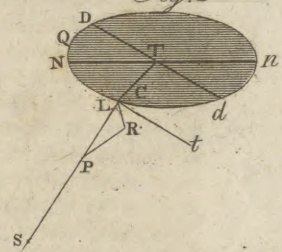


Fig. 2



BRAMIN'S OBSERVATORY.

A. Bell Prin. Wal. Sculptor fecit.

Noncon-formists. Blackst. Comment. called the *toleration act;* which declares, that neither the laws above mentioned, nor the statutes 1 Eliz. c. 2. § 14. 3 Jac. I. c. 4. and 5. nor any other penal laws made against Popish recusants (except the test acts), shall extend to any dissenters, other than Papists and such as deny the Trinity: provided, 1. That they take the oaths of allegiance and supremacy, (or make a similar affirmation, being Quakers), and subscribe the declaration against Popery. 2. That they repair to some congregation certified to and registered in the court of the bishop or archdeacon, or at the county sessions. 3. That the doors of such meeting-house shall be unlocked, unbarred, and unbolted; in default of which, the persons meeting there are still liable to all the penalties of the former acts. Dissenting teachers, in order to be exempted from the penalties of the statutes 13 and 14 Car. II. c. 4. 17 Car. II. c. 2. and 22 Car. II. c. 1. are also to subscribe the articles of religion mentioned in the statute 13 Eliz. c. 12. (viz. those which only concern the confession of the true Christian faith, and the doctrine of the sacraments), with an express exception of those relating to the government and powers of the church, and to infant baptism. And by stat. 10 Ann. c. 2. this toleration is ratified and confirmed; and it is declared, that the said act shall at all times be inviolably observed for the exempting such Protestant dissenters as are thereby intended from the pains and penalties therein mentioned. Thus, though the offence of nonconformity is by no means universally abrogated, it is suspended, and ceases to exist with regard to these Protestant dissenters, during their compliance with the conditions imposed by the act of toleration: and, under these conditions, all persons, who will approve themselves no Papists or oppugners of the Trinity, are left at full liberty to act as their consciences shall direct them in the matter of religious worship. And if any person shall wilfully, maliciously, or contemptuously disturb any congregation, assembled in any church or permitted meeting-house, or shall misuse any preacher or teacher there, he shall (by virtue of the same statute) be bound over to the sessions of the peace, and forfeit 20l. But by statute 5 Geo. I. c. 4. no mayor or principal magistrate must appear at any dissenting meeting with the ensigns of his office, on pain of disability to hold that or any other office: the legislature judging it a matter of propriety, that a mode of worship, set up in opposition to the national, when allowed to be exercised in peace, should be exercised also with decency, gratitude, and humility. Neither doth the act of toleration extend to enervate those clauses of the statutes 13 & 14 Car. II. c. 4. and 17 Car. II. c. 2. which prohibit (upon pain of fine and imprisonment) all persons from teaching school, unless they be licensed by the ordinary, and subscribe a declaration of conformity to the liturgy of the church, and reverently frequent divine service *established* by the laws of this kingdom.

"As to *Papists* what has been said of the Protestant dissenters would hold equally strong for a general toleration of them; provided their separation was founded only upon difference of opinion in religion, and their principles did not also extend to a subversion of the civil government. If once they could be brought to renounce the supremacy of the Pope, they might quietly enjoy their seven sacraments; their purgatory, and auricular confession; their worship of relicks and images; nay, even their transubstantiation. But while they acknowledge a foreign power, superior to the sovereignty of the kingdom, they cannot complain, if the laws of that kingdom will not treat them upon the footing of good subjects. Noncon-formists.

"The following are the laws that have been enacted against the Papists; who may be divided into three classes, persons, professing Popery, Popish recusants convict, and Popish priests. 1. Persons professing the Popish religion, besides the former penalties for not frequenting their parish church, are disabled from taking any lands either by descent or purchase, after 18 years of age, until they renounce their errors; they must at the age of 21 register their estates before acquired, and all future conveyances and wills relating to them; they are incapable of presenting to any advowson, or granting to any other person any avoidance of the same; they may not keep or teach any school, under pain of perpetual imprisonment; and, if they willingly say or hear mass, they forfeit the one 200, the other 100 merks, and each shall suffer a year's imprisonment. Thus much for persons, who, from the misfortune of family prejudices, or otherwise, have conceived an unhappy attachment to the Romish church from their infancy, and publicly profess its errors. But if any evil industry is used to rivet these errors upon them; if any person sends another abroad to be educated in the Popish religion, or to reside in any religious house abroad for that purpose, or contributes to their maintenance when there; both the sender, the sent, and the contributor, are disabled to sue in law or equity, to be executor or administrator to any person, to take any legacy or deed of gift, and to bear any office in the realm; and shall forfeit all their goods and chattels, and likewise all their real estate for life. And where these errors are also aggravated by apostasy or perversion; where a person is reconciled to the see of Rome, or procures others to be reconciled, the offence amounts to high treason. 2. Popish recusants, convicted in a court of law of not attending the service of the church of England, are subject to the following disabilities, penalties, and forfeitures, over and above those before mentioned. They are considered as persons excommunicated; they can hold no office or employment: they must not keep arms in their houses, but the same may be seized by the justices of the peace; they may not come within 10 miles of London, on pain of 100l.; they can bring no action at law or suit in equity; they are not permitted to travel above five miles from home, unless by licence, upon pain of forfeiting all their goods; and they may not come to court, under pain of 100l. No marriage or burial of such recusant, or baptism of his child, shall be had otherwise than by the ministers of the church of England, under other severe penalties. A married woman, when recusant, shall forfeit two-thirds of her dower or jointure, may not be executrix or administratrix to her husband, or have any part of his goods; and during the coverture may be kept in prison, unless her husband redeems her, at the rate of 10l. a month, or the third part of all his lands. And lastly, as a feme-covert recusant may be imprisoned, so all others must, within three months after conviction, either submit and renounce their errors, or, if required so to do by four justices, must abjure and renounce the realm: and if they do not depart, or if they return

Nonconformists.

Blackst. Comment.

turn without the king's licence, they ſhall be guilty of felony, and ſuffer death as felons, without benefit of clergy. There is alſo an inferior ſpecies of recuſancy, (refuſing to make the declaration againſt Popery enjoined by ſtatute 30 Car. II. ſt. 2. when tendered by the proper magiſtrate); which, if the party reſides within ten miles of London, makes him an abſolute recuſant convict; or, if at a greater diſtance, ſuſpends him from having any ſeat in parliament, keeping arms in his houſe,or any horſe above the value of 5l. 3. Popiſh prieſts are in a ſtill more dangerous condition. By ſtatute 11 & 12 W. III. c. 4. Popiſh prieſts, or biſhops, celebrating maſs or exerciſing any part of their functions in England, except in the houſes of ambaſſadors, are liable to perpetual impriſonment. And by the ſtatute 27 Eliz. c. 2. any Popiſh prieſt, born in the dominions of the crown of England, who ſhall come over hither from beyond ſea (unleſs driven by ſtreſs of weather and tarrying only a reaſonable time), or ſhall be in England three days without conforming and taking the oaths, is guilty of high treaſon: and all perſons harbouring him are guilty of felony without the benefit of clergy.

"This is a ſhort ſummary of the laws againſt the Papiſts; of which the preſident Monteſquieu obſerves, that they are ſo rigorous, though not profeſſedly of the ſanguinary kind, that they do all the hurt that can poſſibly be done in cold blood. But in anſwer to this, it may be obſerved (what foreigners who only judge from our ſtatute book are not fully apprized of), that theſe laws are ſeldom exerted to their utmoſt rigour: and indeed, if they were, it would be very difficult to excuſe them. For they are rather to be accounted for from their hiſtory, and the urgency of the times which produced them, than to be approved (upon a cool review) as a ſtanding ſyſtem of law. The reſtleſs machinations of the Jeſuits during the reign of Elizabeth, the turbulence and uneaſineſs of the Papiſts under the new religious eſtabliſhment, and the boldneſs of their hopes and wiſhes for the ſucceſſion of the queen of Scots, obliged the parliament to counteract ſo dangerous a ſpirit by laws of a great, and then perhaps neceſſary, ſeverity. The powder-treaſon, in the ſucceeding reign, ſtruck a panic into James I. which operated in different ways: it occaſioned the enacting of new laws againſt the Papiſts; but deterred him from putting them in execution. The intrigues of Queen Henrietta in the reign of Charles I. the proſpect of a Popiſh ſucceſſor in that of Charles II. the aſſaſſination-plot in the reign of King William, and the avowed claim of a Popiſh pretender to the crown in ſubſequent reigns, will account for the extenſion of theſe penalties at thoſe ſeveral periods of our hiſtory." But now that all juſt fears of a pretender may be ſaid to have vaniſhed, and the power and influence of the pope has become feeble, ridiculous, and deſpicable, not only in Britain, but in almoſt every kingdom of Europe: and as in fact the Britiſh Catholics ſolemnly diſclaim the dangerous principles aſcribed to them *; the Britiſh legiſlature, giving way to that liberality of ſentiment becoming Proteſtants, have lately repealed the moſt rigorous of the above edicts, viz. The puniſhment of Popiſh prieſts or Jeſuits who ſhould be found to teach or officiate in the ſervices of that church; which acts were felony in foreigners, and high treaſon in the natives of this kingdom:—The forfeitures of Popiſh heirs, who had received their education abroad; and whoſe eſtates went to the next Proteſtant heir:—The power given to the ſon, or other relation, being a Proteſtant, to take poſſeſſion of the father's or other relation's eſtate, during the life of the real proprietor: —And the debarring Papiſts from the power of acquiring any legal property by purchaſe.—In propoſing the repeal of theſe penalties, it was obſerved, That, beſides that ſome of them had now ceaſed to be neceſſary, others were at all times a diſgrace to humanity. The impriſonment of a Popiſh prieſt for life, only for officiating in the ſervices of his religion, was horrible in its nature: And although the mildneſs of government had hitherto ſoftened the rigour of the law in the practice, it was to be remembered that the Roman Catholic prieſts conſtantly lay at the mercy of the baſeſt and moſt abandoned of mankind—of common informers; for on the evidence of any of theſe wretches, the magiſterial and judicial powers were of neceſſity bound to enforce all the ſhameful penalties of the act. Others of theſe penalties held out the moſt powerful temptations for the commiſſion of acts of depravity, at the very thought of which our nature recoils with horror: They ſeemed calculated to looſen all the bands of ſociety: to diſſolve all civil, moral, and religious obligations and duties, to poiſon the ſources of domeſtic felicity, and to annihilate every principle of honour. The encouragement given to children to lay their hands upon the eſtates of their parents, and the reſtriction which debars any man from the honeſt acquiſition of property, need only to be mentioned to excite indignation in an enlightened age.

* See their Loyal Addreſs to the throne, May 1. 1778, as inſerted in the Magazines or Annual Regiſter for that year.

Nonconformiſts.

In order the better to ſecure the Engliſh eſtabliſhed church againſt perils from nonconformiſts of all denominations, Infidels, Turks, Jews, Heretics, Papiſts, and Sectaries, there are, however, two bulwarks erected; called the *corporation* and *teſt acts*: By the former of which, no perſon can be legally elected to any office relating to the government of any city or corporation, unleſs, within a twelvemonth before, he has received the ſacrament of the Lord's ſupper according to the rites of the church of England; and he is alſo enjoined to take the oaths of allegiance and ſupremacy at the ſame time that he takes the oath of office: or, in default of either of theſe requiſites, ſuch election ſhall be void. The other, called the *teſt act*, directs all officers civil and military to take the oaths and make the declaration againſt tranſubſtantiation, in any of the king's courts at Weſtminſter, or at the quarter ſeſſions, within ſix kalendar months after their admiſſion; and alſo within the ſame time to receive the ſacrament of the Lord's ſupper, according to the uſage of the church of England, in ſome public church immediately after divine ſervice and ſermon, and to deliver into court a certificate thereof ſigned by the miniſter and church warden, and alſo to prove the ſame by two credible witneſſes; upon forfeiture of 500l. and diſability to hold the ſaid office. And of much the ſame nature with theſe is the ſtatute 7 Jac. I. c. 2. which permits no perſons to be naturalized or reſtored in blood, but ſuch as undergo a like teſt: which teſt having been removed in 1753, in favour of the Jews, was the next ſeſſion of parliament reſtored again with ſome precipitation.

Non-

Non-naturals || Nonius.

NON-Naturals, in *Medicine*, so called, because by their abuse they become the causes of diseases.

Physicians have divided the non-naturals into six classes, viz. the air, meats and drinks, sleep and watching, motion and rest, the passions of the mind, the retentions and excretions. See MEDICINE, *passim*.

NON-Obstante (notwithstanding) a clause frequent in statutes and letters patent, importing a license from the king to do a thing, which at common law might be lawfully done, but being restrained by act of parliament cannot be done without such license.

NON-Pros. See NOLLE *Prosequi*.

NON-Suit, signifies the dropping of a suit or action, or a renouncing thereof by the plaintiff or defendant; which happens most commonly upon the discovery of some error in the plaintiff's proceedings when the cause is so far proceeded in, that the jury is ready at the bar to deliver in their verdict.

NONES, (NONÆ), in the Roman kalendar, the fifth day of the months January, February, April, June, August, September, November, and December; and the seventh of March, May, July, and October. March, May, July, and October, had six days in their nones; because these alone, in the ancient constitution of the year by Numa, had 31 days a-piece, the rest having only 29, and February 30: but when Cæsar reformed the year, and made other months contain 31 days, he did not allot them six days of nones.

NONJURORS, those who refused to take the oaths to government, and who were in consequence under certain incapacities, and liable to certain severe penalties. It can scarcely be said that there are any nonjurors now in the kingdom; and it is well known that all penalties have been removed both from Papists and Protestants, formerly of that denomination, as well in Scotland as in England. The members of the Episcopal church of Scotland have long been denominated Nonjurors; but perhaps they are now called so improperly, as the ground of their difference from the establishment is more on account of ecclesiastical than political principles.

NONIUS, PETER, in Spanish *Nunez*, a learned Portuguese, and one of the ablest mathematicians of the 16th century, was born at Alcacer. He was preceptor to Don Henry, King Emmanuel's son, and taught the mathematics in the university of Coimbra. He published the following works, by which he gained great reputation: 1. *De arte Navigandi*. 2. *Annotations in theorias planetarum Purbachii*; which are greatly esteemed. 3. A treatise *De Crepusculis*. 4. A treatise on Algebra. It is observed in Furetiere's dictionary, that Peter Nonius, in 1530, first invented the angles of 45 degrees made in every meridian, and that he called them *rhumbs* in his language, and calculated them by spherical triangles. Nonius died in 1577, aged 80.

NONIUS, the name which was not many years ago given to the common device for subdividing the arcs of quadrants and other astronomical instruments, from the persuasion that it was invented by *Nonius* or *Nunez*, of whom some account has been given in the preceding article. The generality of astronomers of the present age transferring the honour of the invention from *Nunez* to *Peter Vernier*, a native of Franche Comte, have called this method of division by his name. (See VERNIER.) Mr Adams, however, in his *Geometrical and Geographical Essays*, has lately shown that Clevius the Jesuit may dispute the invention with them both. The truth seems to be, that Nunez started the idea, Clevius improved it, and Vernier carried it to its present state of perfection. The method of Nunez, described in his treatise *De Crepusculis*, printed at Lisbon 1542, consists in describing within the same quadrant 45 concentric circles, dividing the outermost into 90 equal parts, the next within into 89, the next into 88, &c. till the innermost was divided into 46 only. On a quadrant thus divided the plumb line or index must cross one or other of the circles very near a point of division; whence, by computation, the degrees and minutes of the arch might be easily ascertained. This method is also described by Nunez in his treatise *De arte atque ratione Navigandi*, where he would fain persuade himself, that it was not unknown to Ptolemy. But as the degrees are thus divided very unequally, and as it is very difficult to attain exactness in the division, especially when the numbers into which the arches are to be divided are incomposite (of which there are no less than nine), the method of diagonals, first published by Thomas Digges, Esq. in a treatise entitled *Alæ seu scalæ mathematicæ*, printed at London in 1573, and said to be invented by one Richard Chenseler, was substituted in its room. Nonius's method was, however, improved at different times and by different persons; and it must be acknowledged, that if Vernier saw either the original or any of the improvements (and there can be little doubt of his having seen them all), his merit is only that of having applied to an useful practical purpose the speculative invention of another person.

Nonius || Nootka Sound.

NONNUS, a Greek poet of the 5th century, and native of Panopilis in Egypt, was the author of an heroic poem in 48 books, entitled *Dionysiacorum*, and a paraphrase in verse of St John's Gospel, which may serve as a commentary upon it.

NONUPLA, in the Italian music, denotes a quick time, peculiar to jigs. This species of time is otherwise called *the measure of nine times*, which requires two falls of the hand, and one rise. There are three sorts of nonupla. 1. *Nonupla di semi minime*, or *dupla sesquiquarta*, thus marked $\frac{9}{4}$, where nine crotchets are to be in the bar, of which four make a semibreve in common time, i. e. in the down stroke six, and but three up: it is usually beat *adagio*. 2. *Nonupla di crome*, or *sesqui ottava*, marked thus $\frac{9}{8}$, wherein nine quavers make a bar instead of eight in common time, i. e. six down and three up: it is beat *presto*. 3. *Nonupla di semicrome* or *super setti partiente nona*, thus distinguished $\frac{9}{16}$, in which nine semiquavers are contained in a bar, whereof sixteen are required in common time, six down, and three up: it is ordinarily beat *prestissimo*. Besides these, there are two other species of nonupla, for which see TRIPLE.

NOOTKA SOUND, or, as it was called by Captain Cook, *King George's Sound*, lies in N. Lat. 49. 33. W. Long. 153. 12. It is an entrance or strait to a vast inland sea on the west coast of North America, and is said to resemble the Baltic or Mediterranean in Europe. Upon the sea-coast the land is tolerably high and level; but within the sound it rises into steep hills, which have an uniform appearance. The trees of which the woods are composed, are the Canadian pine, white cypress, Nootka Sound.

cypress, and two or three other sorts of pine. In general, the trees grow here with great vigour, and are of a large size. About the rocks and borders of the woods were seen some strawberry plants, and raspberry, currant, and gooseberry bushes, all in a flourishing state. The principal animals seen here were racoons, martens, and squirrels. Birds are far from being numerous, and those that are to be seen are remarkably shy, owing perhaps to their being continually harassed by the natives, either to eat them, or to become possessed of their feathers to be worn as ornaments. The quebrantahuessos, shags, and gulls, were seen off the coast; and the two last were also frequent in the sound. Though the variety of fish is not very great, yet they are in greater quantities than birds. The principal sorts are the common herring, a silver coloured bream, and another of a brown colour. Captain Cook and Mr King, who visited this place, consider it as an excellent shelter for ships: and in the account of *A Voyage to the Pacific Ocean*, they give some directions for sailing into it. These and other matters of that kind we shall not trouble our readers with; and perhaps the generality of them will be better pleased with the following extract from Meares's Voyages to the North-west Coast of America.

"The people of the Nootka nation are, in general, robust and well-proportioned:—their faces are large and full, their cheeks high and prominent, with small black eyes:—their noses are broad and flat, their lips thick, and they have generally very fine teeth, and of the most brilliant whiteness.

"The manner in which the children of Nootka are treated, when young, is not more extraordinary from its strange, and, as it should appear, total inutility, as from its agreement with the customs of the Chinese and Tartars, to whom this practice gives these people a considerable resemblance. The head of the infant is bound by the mother with a kind of fillet of several folds, as low down as the eyes, in order to give it a certain form, which, at this tender age, it is capable of receiving. It might be supposed, that such a tight drawn ligature must cause considerable pain to the child; but we never observed that any of the infants, in such a state of preparation for sugar-loaf heads, suffered any visible pain or inconvenience.

"Though the custom of compressing the head in this manner gives them an unpleasant appearance, by drawing up the eyebrows, and sometimes producing the disagreeable effect of squinting, as well as of flattening the nose and distending the nostrils, they are by no means an ill-looking race of people. They have also the custom, which is known to prevail in so many Indian nations, of plucking out the beard by the roots, on its first appearance; and, as it continues to sprout, to keep it down by the same practice. It is one of the domestic employments assigned to their wives, to watch this appearance of manhood, and to eradicate the hairs as they come forth; which they do in a very dexterous manner with their fingers, and without giving the least pain in the operation.—Some of them, however, though we saw but very few of this disposition, when they advance in years and become infirm, suffer their beards to grow without interruption. But, notwithstanding they have so great an aversion to the hair of their chin, that of the head is an object of their attentive vanity: it is strong, black, and glossy; grows to a considerable length; and is either tied in a kind of knot on the top of their heads, or suffered to hang down their backs in flowing negligence.

"In their exterior form they have not the symmetry or elegance which is found in many other Indian nations.—Their limbs, though stout and athletic, are crooked and ill shaped; their skin, when cleansed of filth and ochre, is white; and we have seen some of the women, when in a state of cleanliness (which, however, was by no means a common sight, and obtained with difficulty), who not only possessed the fair complexion of Europe, but features that would have attracted notice, for their delicacy and beauty, in those parts of the world where the qualities of the human form are best understood. But these examples of beauty are by no means numerous among the women of Nootka, who are calculated rather to disgust than to charm an European beholder. Their hair, like that of the men, is black; their eyes are of the same colour; and, in exterior appearance, they are not to be immediately distinguished from the men. In their characters they are reserved and chaste; and examples of loose and immodest conduct were very rare among them. There were women in St George's Sound, whom no offers could tempt to meretricious submissions."

All reports concerning Nootka Sound agree in characterizing the inhabitants as "a very inoffensive race of people."—Inoffensive, however, as they are, a custom of a very unnatural, and we should imagine cruel, kind prevails among them: for, together with many other articles which they exposed to sale to Captain Cook's ships, they brought human skulls and hands (part of the flesh still remaining on them), which they acknowledged they had been feeding on; and some of them, we are told, had evident marks of the fire.

From hence it is too apparent, that the horrid practice of devouring their enemies exists here as well as at New Zealand and other South sea islands: and hence, too, appears what men of even the best natural dispositions will be, if left entirely to the freedom of their own will, without law to controul or religion to instruct them. As there are but two villages of the Sound inhabited, the number of people cannot be many; perhaps they are about 2000 in all. Our limits prevent us from being so minute as we could wish to be, respecting the form of their houses and their manner of building them; of their furniture, decorations, and other things of that kind: we can therefore only refer those who wish for further information on this subject to Cook, and other voyagers and travellers, &c.

The employment of the men is chiefly fishing, &c. whilst the women manufacture their garments. Their ingenuity in this and in the mechanic arts is far from being inconsiderable; and in the imitative arts their skill is very great. On these subjects, however, we cannot enlarge: we have in general made it our business, and it certainly is our duty, to dwell, where it can be done, on the manners or religion of the inhabitants of the several places which come under our notice; and they who know the utility of this in developing the philosophy of the human mind, the most important of all sciences, will not blame our intentions, even if they should not approve of the execution. In Cook's

Cook's Voyages before referred to, we find the following obſervations on the religion and language of the inhabitants of Nootka Sound.

"Little knowledge we can be ſuppoſed to have acquired of the political and religious inſtitutions eſtabliſhed among theſe people. We diſcovered, however, that there were ſuch men as chiefs, diſtinguiſhed by the title of *Acweek*, to whom the others are, in ſome degree, ſubordinate. But the authority of each of theſe great men ſeems to extend no farther than to his own family, who acknowledge him as their head. As they were not all elderly men, it is poſſible this title may be hereditary.

"Nothing that we ſaw could give us any inſight into their notions of religion, except the figures already mentioned, called *Klumma*. Theſe, perhaps, were idols; but as the word *acweek* was frequently mentioned when they ſpoke of them, we may ſuppoſe them to be the images of ſome of their anceſtors, whoſe memories they venerate. This, however, is all conjecture; for we could receive no information concerning them; knowing little more of their language than to enable us to aſk the names of things, and being incapable of holding any converſation with the natives relative to their traditions or their inſtitutions.

"Their language is neither harſh nor diſagreeable, farther than proceeds from their pronouncing the *k* and *h* with leſs ſoftneſs than we do. As to the compoſition of their language, we are enabled to ſay but little. It may, however, be inferred from their ſlow and diſtinct method of ſpeaking, that it has few prepoſitions or conjunctions, and is deſtitute of even a ſingle interjection to expreſs ſurpriſe or admiration. The affinity it may bear to other languages, we have not been able ſufficiently to trace, not having proper ſpecimens to compare it with; but from the few Mexican words we have procured, there is an obvious agreement throughout the language, in the frequent terminations of the words in *l*, *tl* or *z*.

"The word *wakaſh* was frequently in the mouths of the people of Nootka. It ſeemed to expreſs approbation, applauſe, and friendſhip. Whenever they appeared to be pleaſed or ſatisfied at any ſight or occurrence, they would call out *wakaſh! wakaſh!*—It is worthy of remark, that as theſe people do eſſentially differ from the natives of the iſlands in the Pacific ocean, in their perſons, cuſtoms, and language, we cannot ſuppoſe their reſpective progenitors to have belonged to the ſame tribe, when they emigrated into thoſe places where we now find their deſcendants."

We cannot finiſh this article without taking notice of a circumſtance, which at the time made a great noiſe in Europe, and which it is probable will find a place in the future hiſtories of the contending countries.

A ſmall aſſociation of Britiſh merchants reſident in the Eaſt Indies had, early in the year 1786, formed the project of opening a trade to this part of the world, for the purpoſe of ſupplying the Chineſe market with furs. The principal point towards which theſe expeditions were directed, was Port Nootka, or King George's Sound; and the adventurers, being in ſome degree ſatisfied with their traffic, took meaſures, in the year 1788, to ſecure to themſelves a permanent ſettlement; at the ſame time that the ſhipping employed in this expedition was generally two, and never exceeded the amount of four, ſmall veſſels. The Spaniards conceived ſome jealouſy of the intruſion of the Engliſh into a part of the world which they had long been deſirous to regard as their excluſive property; and accordingly a Spaniſh frigate of 26 guns was deſpatched from the province of Mexico, for the purpoſe of putting an end to this commerce. The Spaniſh frigate arrived in May 1789, and captured two Engliſh veſſels in the following July, at the ſame time taking poſſeſſion of the little ſettlement which had been formed upon the coaſt. Such, in ſhort, is the circumſtance which was likely to involve us in an expenſive war. Happily, however, for both countries, and perhaps for Europe, the matter was at length, after great altercation, amicably ſettled; and it muſt ſtill be ſo freſh in the memories of our readers, that we truſt they will excuſe us from enlarging further upon it—the whole article having extended perhaps to more than a ſufficient length.

NOPAL, Raquette, or *Indian fig;* plants ſo named by the Indians, on which the cochineal inſect breeds in Mexico. See Cochineal, Dyeing *Index*.

NOPALXOCHQUETZALLI, or Nopalcochquetzalli, the prickly pear of Mexico, which is common over all the Weſt Indies. See Cactus, Botany *Index*.

NOPH. See Memphis.

NORBURY, a town of Staffordſhire, in England, on the ſouth-weſt ſide of Eccleſhall. Here is a ſurpriſing echo, which, taken 440 yards north-eaſt from the manor houſe, near a little bank under a wood ſide, repeats in a ſtill day 10 or 11 ſyllables very diſtinctly, or 12 or 13, if ſpoke very quick. It is remarked that the banks of the Black Meer, in this pariſh, grow forward every year over the ſurface of the water, at the rate of three or four yards every ſeven years.

NORDEN, Frederic Lewis, an ingenious traveller and naval officer in the Daniſh ſervice, was born at Gluckſtadt in Holſtein in the year 1708. He was well ſkilled in mathematics, ſhip-building, and eſpecially in architecture; and in 1732 obtained a penſion to enable him to travel for the purpoſe of ſtudying the conſtruction of ſhips, particularly the galleys and other rowing veſſels uſed in the Mediterranean. He ſpent near three years in Italy; and Chriſtian VI. being deſirous of obtaining a circumſtantial account of Egypt, Mr Norden while at Florence received an order to extend his travels to that country. How he acquitted himſelf in this commiſſion, appears from his Travels into Egypt and Nubia, printed at Copenhagen in folio, 1756; and which were ſoon after tranſlated into Engliſh by Dr Peter Templeman. In the war between England and Spain, Mr Norden, then a captain in the Daniſh navy, attended Count Ulric Adolphus, a ſea captain, to England; and they went out volunteers under Sir John Norris, and afterwards under Sir Chaloner Ogle. During his ſtay in London, Mr Norden was made a fellow of the Royal Society, and gave the public drawings of ſome ruins and coloſſal ſtatues at Thebes in Egypt, with an account of the ſame in a letter to the Royal Society, 1741. His health at this time was declining; and taking a tour to France, he died at Paris in 1742.

NORDHEIM, a town in Germany, in the Hanover

Nores, Norfolk.

ver quarter. Of the four larger towns of this principality, it is the third in order. It is situated on the Ruhme, which runs into the Leine. It contains 500 houses, and, besides a secularized Lutheran abbey, has one parish church, and some charitable foundations, and also enjoys some manufactures.

NORES, Jason de, a scholar, poet, and philosopher, was born at Nicosia in Cyprus. He lost his fortune when the Turks made themselves masters of that island in 1570. He retired to Padua; where he acquired great reputation by teaching moral philosophy. His character had that cast of severity which is often the consequence of scholastic habits. He was one of those men who discuss every thing without being capable of feeling any thing. The *Pastor Fido* of Guarini made its appearance; and pastorals became a fashionable species of reading throughout all Italy. Nores, who did not relish works of this kind, attacked the production of Guarini; who entirely confuted him in a little piece printed at Ferrara in 1588. Nores made a reply two years after; and the poet was preparing an answer still more severe than the former, when his antagonist died of grief, occasioned by the banishment of his only son for having killed a Venetian in a duel. He left behind him a great many works, some in Italian, and others in Latin. The chief of his Italian works, are, 1. The Poeticks, Padua, 1588, 4to; this edition is rare. 2. A Treatise on Republics, 1578, 4to; which he forms on the model of that of the Venetians, his masters. 3. A Treatise on the World and its Parts, Venice, 1571, 8vo. 4. Introduction to three books of Aristotle's Rhetoric, Venice, 1584, 4to, valuable. 5. A Treatise on what Comedy, Tragedy, and Epic Poetry, may receive from Moral Philosophy. His Latin works are, 1. *Institutio in Philosophiam Ciceronis*, Padua, 1576, 8vo. 2. *Brevis et distincta summa præceptorum de arte discendi, ex libris Ciceronis collecta*, Venice, 1553, 8vo.; a good work. 3. *De Constitutione partium humanæ et civilis philosophiæ*, 4to. 4. *Interpretatio in artem poeticam Horatii*, &c. In all his works we remark great perspicuity and accuracy, profound erudition, happy expressions, an elevated and sometimes forcible style.—His son Peter Nores, successively secretary to several cardinals, at once a man of letters and a man of business, left behind him different manuscripts; among others, the life of Paul IV. in Italian.

NORFOLK, a county of England, so called from its northern situation in respect of Suffolk, is bounded on the east and north by the German ocean; on the south by Suffolk, from which it is parted by the rivers Waveney and the Lesser Ouse; and on the west it is separated from Cambridgeshire by the Greater Ouse, and from a small part of Lincolnshire by the Washes. According to Templeman, it extends in length 57 miles, in breadth 35, and 140 in circumference. It contains an area of 1426 square miles, one city, 32 market towns, 711 villages, according to the book of rates, though some make them 1500, and 273,371 inhabitants. It is divided into 31 hundreds, 164 vicarages, and 660 parishes.

The air differs in different parts of the county according to the soil, which in some places is marshy, especially on the sea coast, and there the air is foggy and unwholesome; in others it is clayey and chalky, poor, lean, and sandy, and there the air is good. The county is almost all champaign, except in some places, where rise gentle hills. The marsh lands yield rich pasture for cattle; the clay grounds pease, rye, and barley; and the sandy heaths feed vast flocks of large sheep, of which some villages are said to keep 4000 or 5000. These heaths abound also in rabbits of a silver gray colour. Walsingham is noted for producing the best saffron. Great quantities of mackarel and herring are caught upon the coasts of this county, the former in the spring, and the latter in September; especially at Yarmouth, where they are cured in a particular manner, and to great perfection. Wood and honey are also very plentiful in this county; and on the coasts jet and ambergrease are sometimes found. The inhabitants are generally strong and active, sagacious and acute. That they are so robust, is the more to to be wondered at, because the common people live much on puddings, *Norfolk dumplings*. They are for the most part in easy circumstances, and were formerly very quarrelsome and litigious. In consequence of this disposition, lawyers swarmed among them to such a degree, that a statute was made so early as the reign of Henry VI. to restrain their number. The manufactures of the county, which is exceedingly populous, are chiefly woollen and worsted stuffs and stockings, for which they are well supplied with wool from the vast flocks of sheep bred in it. It gives title of duke to the elder branch of the family of Howard, lies in the diocese of Norwich, and sends twelve members to parliament, viz. two knights for the shire, two citizens for Norwich, and two burgesses for each of the boroughs of Lynn Regis, Great Yarmouth, Thetford, and Castlerising.

The county is well watered, and supplied with fish by the rivers Yare, Thyrn, Waveney, the Greater and Lesser Ouse, and the Bure, besides rivulets. The Bure abounds in excellent perch, and the Yare has a fish peculiar to it called the *ruffe*. The latter rises about the middle of the county; and after being joined by the Waveney and Bure, falls into the sea at Yarmouth. At the equinoxes, especially the autumnal, the Ouse is subject to great inundations, being forced back by the sea, that enters it with great fury. This county was famous at a very early period for its fisheries, which were extensive and valuable, and seem to have been carried on with spirit. It has also been remarkable, for at least 400 years past, for the manufacture of fine worsted stuffs.

Norfolk, Norfolk Island.

Norfolk, a county of Virginia contiguous to North Carolina.

Norfolk Island, a small island of the South sea, lying in 29° 12′ 30″ south latitude, and 168° 16′ east longitude. A colony was lately settled on it: and the following account of it is given in *Governor Phillip's Voyage to Botany Bay*, &c.

"Norfolk island is about seven leagues in circumference; and if not originally formed, like many other small islands, by the eruption of volcanic matter from the bed of the sea, must doubtless have contained a volcano. This conclusion is formed from the vast quantity of pumice stone which is scattered in all parts of it, and mixed with the soil. The crater, or at least some traces of its former existence, will probably be found at the summit of a small mountain, which rises

Norfolk Island.

rises near the middle of the island. To this mountain the commandant has given the name of *Mount Pitt.* The island is exceedingly well watered. At or near Mount Pitt rises a strong and copious stream, which flowing through a very fine valley, divides itself into several branches, each of which retains sufficient force to be used in turning mills; and in various parts of the island springs have been discovered.

"The climate is pure, salubrious, and delightful; preserved from oppressive heats by constant breezes from the sea, and of so mild a temperature throughout the winter, that vegetation continues there without interruption, one crop succeeding another. Refreshing showers from time to time maintain perpetual verdure: not indeed of grass, for none has yet been seen upon the island: but of the trees, shrubs, and other vegetables, which in all parts grow abundantly. On the leaves of these, and of some kinds in particular, the sheep, hogs, and goats, not only live, but thrive and fatten very much. To the salubrity of the air every individual in this little colony can bear ample testimony, from the uninterrupted state of good health which has been in general enjoyed.

"When our settlers landed, there was not a single acre clear of wood in the island, and the trees were so bound together by that kind of creeping shrub called *supple jack*, interwoven in all directions, as to render it very difficult to penetrate far among them. The commandant, small as his numbers were at first, by indefatigable activity soon caused a space to be cleared sufficient for the requisite accommodations, and for the production of esculent vegetables of all kinds in the greatest abundance. When the last accounts arrived, three acres of barley were in a very thriving state, and ground was prepared to receive rice and Indian corn. In the wheat there had been a disappointment, the grain that was sown having been so much injured by the weevil as to be unfit for vegetation. But the people were all at that time in commodious houses; and, according to the declarations of Mr King himself, in his letters to Governor Philip, there was not a doubt that this colony would be in a situation to support itself entirely without assistance in less than four years; and with very little in the intermediate time. Even two years would be more than sufficient for this purpose, could a proper supply of black cattle be sent.

"Fish are caught in great plenty, and in the proper season very fine turtle. The woods are inhabited by innumerable tribes of birds, many of them very gay in plumage. The most useful are pigeons, which are very numerous; and a bird not unlike the Guinea fowl, except in colour (being chiefly white), both of which were at first so tame as to suffer themselves to be taken by hand. Of plants that afford vegetables for the table, the chief are cabbage palm, the wild plantain, the fern tree, a kind of wild spinage, and a tree which produces a diminutive fruit, bearing some resemblance to a currant. This, it is hoped, by transplanting and care, will be much improved in size and flavour.

"But the productions which give the greatest importance to Norfolk Island are the pines and the flax plant; the former rising to a size and perfection unknown in other places, and promising the most valuable supply of masts and spars for our navy in the East Indies; the latter not less estimable for the purposes of making sailcloth, cordage, and even the finest manufactures, growing in great plenty, and with such luxuriance as to attain the height of eight feet. The pines measure frequently 160, or even 180 feet in height, and are sometimes 9 or 10 feet in diameter at the bottom of the trunk. They rise to about 80 feet without a branch: the wood is said to be of the best quality, almost as light as that of the best Norway masts; and the turpentine obtained from it is remarkable for purity and whiteness. The fern tree is found also of a great height for its species, measuring from 70 to 80 feet, and affords excellent food for the sheep and other small cattle. A plant producing pepper, and supposed to be the true oriental pepper, has been discovered lately in the island, growing in great plenty; and specimens have been sent to England in order to ascertain this important point."

Norfolk Sound || Noria.

NORFOLK Sound, according to the account of Captain George Dixon, is situated in 57° 3′ north latitude, and 135° 36′ west longitude. It is a very extensive place, but how far it stretches to the northward is not known. There may possibly be a passage through to the Bay of Islands, but neither is this certain. The shore, in common with the rest of the coast, abounds with pines; there are also great quantities of the witch hazel. There are various kinds of flowering trees and shrubs, wild gooseberries, currants, and raspberries; wild parsley is found here in great plenty, and it eats excellently either as a salad or boiled amongst soup. The saranne, or wild lily root, grows also in great plenty and perfection. There are a very few wild geese or ducks seen here, but they are shy and difficult of approach.

NORHAM, a town in England, in the county of Northumberland, on the river Tweed, near the mouth of the Till, under the castle, which was anciently erected on a steep rock moated round, for the better security against the incursions of the Scotch moss troopers. It is of great antiquity; and its old church has lately received repairs, and been made a decent place of worship. Antiquities have been discovered here. The church had the privilege of a sanctuary. The castle has been frequently honoured with the presence of sovereigns, particularly Edward I. here received the oath of treaty from John Baliol of Scotland. It has been a formidable structure, a great part of which is in ruins; the site of which, with its demesnes, consisted of 1030 acres.

NORIA, a hydraulic machine much used in Spain. It consists of a vertical wheel of 20 feet diameter, on the circumference of which are fixed a number of little boxes or square buckets, for the purpose of raising the water out of the well, communicating with the canal below, and to empty it into a reservoir above, placed by the side of the wheel. The buckets have a lateral orifice to receive and to discharge the water. The axis of this wheel is embraced by four small beams, crossing each other at right angles, tapering at the extremities, and forming eight little arms. This wheel is near the centre of the horse walk, contiguous to the vertical axis, into the top of which the horse beam is fixed: but near the bottom it is embraced by four little beams, forming eight arms similar to those above described, on the axis of the water wheel. As the mule which they use goes round,

round, these horizontal arms, supplying the place of cogs, take hold, each in succession, of those arms which are fixed on the axis of the water wheel, and keep it in rotation.

This machine, than which nothing can be cheaper, throws up a great quantity of water; yet undoubtedly it has two defects: the first is, that part of the water runs out of the buckets and falls back into the well after it has been raised nearly to the level of the reservoir: the second is, that a considerable proportion of the water to be discharged is raised higher than the reservoir, and falls into it only at the moment when the bucket is at the highest point of the circle, and ready to descend.

Both these defects might be remedied with ease, by leaving these square buckets open at one end, making them swing on a pivot fixed a little above their centre of gravity, and placing the trough of the reservoir in such a position as to stop their progress whilst perpendicular; make them turn upon their pivot, and so discharge their contents.

From the reservoir the water is conveyed by channels to every part of the garden; these have divisions and subdivisions or beds, some large, others very small, separated from each other by little channels, into which a boy with his shovel or his hoe directs the water, first into the most distant trenches, and successively to all the rest, till all the beds and trenches have been either covered or filled with water.

Mr Townsend, from whom we have taken the above account, thinks, that on account of the extreme simplicity of this machine, it is an invention of the most remote antiquity. By means of it the inhabitants every morning draw as much water from the well as will serve through the day, and in the evening distribute it to every quarter according to the nature of their crops. The reservoirs into which they raise the water are about 20, 30, or even 40 feet square, and three feet high above the surface of the ground, with a stone cope on the wall, declining to the water for the women to wash and beat their clothes upon.

Our limits preclude us from following Mr Townsend farther in the description of a particular noria used at Barcelona; which he conceives to be the original chain pump, or at least its parent. He compares it with similar instruments, and shows its advantages and disadvantages.

NORICUM (Ptolemy, Tacitus); a Roman province, situated between the Danube on the north, and thus separated from ancient Germany; the Alpes Noricæ on the south; the river Ænus on the west, which separates it from Vindelicia; and Mons Cetius on the east, which divides it from Pannonia. Now containing a great part of Austria, all Saltzburg, Stiria, and Carinthia. It was anciently a kingdom under its own kings (Cæsar, Velleius, Suetonius). *Norici* the people, subdued by Tiberius under Augustus, as allies of the Pannonii (Dio, Velleius). Tacitus reckons Noricum among those provinces which were governed by procurators, officers sent by the emperors to receive and dispose of the public revenue according to order. It was divided into two provinces, but at what time uncertain; supposed as low down as Dioclesian and Constantine, *viz.* the *Noricum Ripense*, running along the south side of the Danube; and the *Noricum Mediterraneum*, extending towards the Alps. How far each of these extended in breadth does not appear: all the account we have of the matter being from Sextus Rufus, and the *Notitia Imperii Occidentalis*. Anciently a country famous for its iron and steel (Horace); as is Stiria at this day, a part of Noricum. A climate cold and more sparingly fruitful (Solinus).

NORIN, a river which rises in a corner of the Venetian confines, that runs between the rugged marble hills, and is left entirely to itself from its very source; hence a vast tract of land is overflowed by it, and encumbered with reeds, willows, and wild alders. A small space of ground only remains dry between the roots of the hills and the marsh at a place called *Prud*, and that is all covered with pieces of ancient hewn stones, fragments of inscriptions, columns, and capitals, and bass reliefs of the best age, worn and deformed by time, and the barbarism of the northern people, who begun on that side to destroy Narona. The inhabitants, who go often to cut reeds in the marsh, assert, that the vestiges of that large city may still be seen under water. It appears to have been extended over the plain a great way, and undoubtedly it was three miles in length at the foot of the hills. The ancient road is now under water; and it is necessary to ascend a very steep road, in order to pass the point of a craggy hill, on which, probably before the Roman times, those fortifications were erected that cost Vetinius so much labour.

NORIS, Henry, cardinal, a great ornament of the order of the monks of St Augustine, was descended from the president Jason, or James de Noris, and was born at Verona 1631. He was carefully educated by his father Alexander Noris, originally of Ireland, and well known by his History of Germany. He discovered from his infancy an excellent understanding, great vivacity, and a quick apprehension. His father instructed him in the rudiments of grammar, and procured an able professor of Verona, called *Massoleim*, to be his preceptor. At 15 he was admitted a pensioner in the Jesuits college at Rimini, where he studied philosophy; after which he applied himself to the writings of the fathers of the church, particularly those of St Augustine: and taking the habit in the convent of the Augustine monks of Rimini, he distinguished himself among that fraternity in a short time by his erudition: insomuch, that as soon as he was out of his noviciate or time of probation, the general of the order sent for him to Rome, in order to give him an opportunity of improving himself in the more solid branches of learning. He did not disappoint his superior's expectations. He gave himself up entirely to his study, and spent whole days, and even nights, in the library of the Angeliques of St Augustine. His constant course was to stick to his books 14 hours a day; and this course he continued till he became a cardinal. By this means he became qualified to instruct others; and on this errand he was sent first to Pezaro, and thence to Perousa, where he took his degree of doctor of divinity; after which, proceeding to Padua, he applied himself to finish his History of Pelagianism. He had begun it at Rome at the age of 26; and, having completed his design, the book was printed at Florence, and published in 1673. The great duke of Tuscany invited him the following year

to

Noris, Norkoping. to that city, made him his chaplain, and profeffor of ecclefiaftical hiftory in the univerfity of Pifa, which his highnefs had founded with that view.

In his hiftory he fet forth and defended the condemnation pronounced, in the eighth general council, againft Origen and Mopfuefta, the firft authors of the Pelagian errors: he alfo added an account of the Schifm of Aquileia, and a Vindication of the Books written by St Auguftine againft the Pelagians and Semi-Pelagians. The work had procured him a great reputation, but met with feveral antagonifts, to whom he publifhed proper anfwers: the difpute grew warm, and was carried before the fovereign tribunal of the inquifition. There the hiftory was examined with the utmoft rigour, and the author difmiffed without the leaft cenfure. It was reprinted twice afterwards, and Mr Noris honoured by Pope Clement X. with the title of Qualificator of the Holy Office. Notwithftanding this, the charge was renewed againft the Pelagian Hiftory, and it was dilated afrefh before the inquifition in 1676; but it came out again with the fame fuccefs as at firft. Mr Noris was now fuffered to remain in peace for fixteen years, and taught ecclefiaftical hiftory at Pifa, without any moleftation, till he was called to Rome by Innocent XII. who made him under-librarian of the Vatican in 1692. This poft was the way to a cardinal's hat; his accufers, therefore, took frefh fire, and publifhed feveral new pieces againft him. Hence the Pope appointed fome learned divines, who had the character of having taken neither fide, to re-examine Father Noris's books, and make their report of them. Their teftimony was fo advantageous to the author, that his holinefs made him counfellor of the inquifition. Yet neither did this hinder one of his adverfaries, the moft formidable on account of his erudition, to rife up againft him, and attack him warmly, under the affumed title of a *Scrupulous Doctor of the Sorbonne*. Noris tried to remove thefe fcruples in a work which appeared in 1695, under the title of An Hiftorical Differtation concerning one of the Trinity that fuffered in the Flefh; wherein, having juftified the monks of Scythia, who made ufe of that expreffion, he vindicated himfelf alfo from the imputation of having attainted the Pope's infallibility, of having abufed Vincentius Lirinenfis, and other bifhops of Gaul, as favourers of Semi-Pelagianifm, and of having himfelf gone into the errors of the bifhop of Ypres.

His anfwers to all thefe accufations were fo much to the fatisfaction of the pope, that at length his holinefs honoured him with the purple in 1695. After this, he was in all the congregations, and employed in the moft important affairs; fo that he had little time to fpend in his ftudy, a thing of which he frequently complained to his friends. Upon the death of Cardinal Cafanati, he was made chief library keeper of the Vatican in 1700; and two years afterwards nominated, among others, to reform the kalendar: but he died at Rome in 1704 of a dropfy. He was one of the moft learned men in the laft century: his writings abound with erudition, and are very elegantly finifhed. He was a member of the Academy; whence he affumed the name of Eucrates Agoretico. His works are numerous, and were publifhed at Verona, in 1729 and 1730, in five volumes folio.

NORKOPING, a town of Sweden, in the province of Eaft Gothland, in eaft longitude 15° 30′, latitude 58° 20′. Its name fignifies "the northern market," in the Swedifh language. It ftands on the banks of a large river called *Motala*, which coming from the lake *Vetter*, falls a little lower into a gulf called *Brawicken*. It is the largeft and moft populous town in Sweden, next to Stockholm, conveniently fituated near the fea on a navigable river, which brings large veffels up to the middle of the town. There are fome handfome ftreets, and the houfes in general are neatly built. Some of the churches are worth feeing; but the greateft curiofity are the famous copper mines, where there is a vaft number of people conftantly at work. In this article the town carries on a very good trade; as alfo in feveral other manufactures, as leather, fteel, and guns, which they make the beft in Sweden.

It covers a large fpace of ground, being ten miles in circumference; but the houfes are fmall and fcattered, and the inhabitants do not exceed 10,000. The river Motala flows through the town, forms a feries of cataracts, and is divided into four principal ftreams, which encircle feveral rocky iflands, covered with houfes and manufactories. At the extremity of the town it is navigable for fmall veffels. Several manufactories are eftablifhed in the town; 55 fabrics of cloth, which employ 1500 men; 3 fugar-houfes; 1 of fnuff; 50 mills for grinding corn, which is exported in large quantities; and a brafs foundery. A falmon fifhery gives employment and riches to many of the inhabitants.

Normandy. NORMANDY, a province of France, bounded on the north by the Englifh channel; on the eaft by Picardy and the Ifle of France; on the fouth by Perche and Maine, and one part of Bretagne; and on the weft by the ocean. It is about 155 miles in length, 85 in breadth, and 600 in circumference. It is one of the moft fertile, and brings in the largeft revenue of the kingdom. It abounds in all things except wine, but they fupply that defect by cyder and perry. There are vaft meadows, fat paftures, and the fea yields plenty of fifh. It contains iron, copper, and a great number of rivers and harbours. It carries on a great trade, is very populous, and comprehends a vaft number of towns and villages. It is divided into the Upper and Lower; the Upper borders upon Picardy, and the Lower upon Bretagne. It contains feven diocefes or bifhoprics, Rouen, Bayeux, Avranches, Evreux, Sées, Lifieux, and Coutances, in which they compute 4189 parifhes, and 80 abbeys. The inhabitants are ingenious, and capable of underftanding any arts and fciences, but they are chiefly fond of law. The Normans, a people of Denmark and Norway, having entered France under Rollo, Charles the Simple ceded this country to them in 912, which from that time was called *Normandy*, and contains about 8200 fquare miles. Its chief city is Rouen. Rollo was the firft duke, and held it as a fief of the crown of France, and feveral of his fucceffors after him, till William, the feventh duke, conquered England in 1066: from which time it became a province of England, till it was loft in the reign of King John, and reunited to the crown of France; but the Englifh ftill keep the iflands on the coafts of Normandy.

The principal rivers are the Seine, the Eure, the Aure, the Iton, the Dive, the Andelle, the Rille, the Touque, the Drômee, and the Orne: among the fea ports, the principal are thofe of Dieppe, Havre, Honfleur, Cherburg, and Granville. Rouen is the principal city.

NORMANS, a fierce warlike people of Norway, Denmark, and other parts of Scandinavia. They at different times overran and ravaged most countries in Europe: to the respective histories of those countries we therefore refer for a fuller account of them, as it is impossible to enlarge upon particulars in this place without repeating what has been already said, or may be said, in different parts of the work.

NORMAN Characters, a species of writing introduced into England by William I. From some old manuscripts the Norman writing appears to have been composed of letters nearly Lombardic. In regal grants, charters, public instruments, and law proceedings, this character was used with very little variation from the reign of the Conqueror to that of Edward III. See WRITING.

NORRIS, or NORIS. See NORIS.

NORTH, one of the four cardinal points of the world; being that point of the horizon which is directly opposite to the sun in meridian. The north wind is generally accompanied with a considerable degree of cold. It sometimes blows with almost irresistible fury. It is often mentioned by the classic authors under the name of *Boreas*, which is of Greek original. See BOREAS.

NORTH Pole. See POLE.

NORTH, *Dudley*, *Lord*, the third baron of that accomplished family, was one of the finest gentlemen in the court of King James; but in supporting that character, dissipated and gamed away the greatest part of his fortune. In 1645, he appears to have acted with the parliament; and was nominated by them to be administrator of the admiralty, in conjunction with the great earls of Northumberland, Essex, Warwick, and others. He lived to the age of 85, the latter part of which he passed in retirement; and wrote a small folio of miscellanies, in prose and verse, under this title, A Forest promiscuous of several Seasons Productions, in four parts, 1659.

NORTH, *Dudley*, *Lord*, son of the former, was made knight of the Bath in 1616, at the creation of Charles prince of Wales; and sat in many parliaments, till excluded by the prevailing party in that which condemned the king. From that period Lord North lived privately in the country, and towards the end of his life entertained himself with books, and, as his numerous issue required, with economy; on which he wrote a little tract, called *Observations and advices economical*, 12mo. His other works are, Passages relating to the long parliament; the history of the life of Lord Edward North, the first baron of the family, addressed to his eldest son; and a volume of Essays.

NORTH, *Francis*, *Lord Guildford*, lord-keeper of the great seal in the reigns of Charles II. and James II. was a third son of the second Dudley lord Noth, baron of Kertling; and studied at St John's college in Cambridge, from whence he removed to the Middle Temple. He acquired French, Italian, Spanish, and Dutch; and became not only a good lawyer, but was well versed in history, mathematics, philosophy, and music. He was afterwards made the king's solicitor-general, and was chosen to represent the borough of Lynn in parliament. He succeeded Sir Heneage Finch in the post of attorney-general; and Lord Chief-Justice Vaughan, in the place of lord chief-justice of the common pleas. He was afterwards made keeper of the great seal: and in 1683 was created a baron by the title of *Lord Guildford*. He died at his house at Wroxton in 1685. He wrote a philosophical essay on music: a paper on the gravitation of fluids, considered in the bladders of fishes, printed in Lowthorp's abridgement of the Philosophical Transactions; and some other pieces.

NORTH, Right Honourable *Frederick*, earl of Guildford, Lord North, lord warden and admiral of the Cinque Ports, governor of Dover castle, lord lieutenant and custos rotulorum of Somersetshire, chancellor of the university of Oxford, recorder of Gloucester and Taunton, an elder brother of the Trinity house, president of the Foundling hospital and of the Asylum, a governor of the Turkey Company and of the Charter house, K. G. and LL. D. was born April 13. 1732; and married, May 20. 1756, Miss Ann Speke, an heiress of the ancient family of Dillington in Somersetshire, by whom he has left two sons and three daughters: the eldest son George Augustus, born September 11. 1759, and married, September 30. 1785, to Miss Hobart, succeeds to the earldom and estates. The late earl succeeded his father August 4. 1790. His lordship succeeded the celebrated Mr Charles Townsend as manager of the house of commons and chancellor of the exchequer; and in 1770, on the resignation of the duke of Grafton, was made first lord of the treasury; in which office he continued until the close of the American war, or rather until the formation of the Rockingham ministry, which began the business of peace with the colonies. He was a man of strong mental faculties; and as an orator, at once commanded attention and enforced conviction: but taking the helm at a time when the king's party were unpopular, and when it was supposed that the late earl of Bute was the great machine by which the cabinet was moved, so he continued in that state of unpopularity until he resigned the seals. During the whole of his premiership (and to conduct the helm at that time required uncommonly great abilities) he studiously avoided imposing any taxes that should materially affect the lower class of people. The luxuries, and not the necessaries, of life were repeated objects of his budget. As a financier, he stood high, even in the opinion of opposition; and they were a combination of all the great talents in the kingdom: but, fatally wedded to the destructive plan of subduing the republican spirit of the Americans, his administration will not only stand marked in the page of history with an immense waste of public treasure, but it will appear besprinkled with the kindred blood of thousands of British subjects. To the very last moment he spoke in the senate, however, he defended that war; and said, he was then, as he was formerly, prepared to meet the minutest investigation as to his conduct in that business; which nothing but the unforeseen intervention of France could have prevented from being crowned with success. His lordship was one of the firmest and most strenuous supporters of the constitution in church and state. He died on the 5th of August 1792. His recollection he retained to his last moments: his family, except Lord North, who came within a few minutes afterwards, were assembled round his bed, and he took leave of them individually. Their grief did not suffer them to leave the room for some time after the event;

North Cape || North-west Passage.

event; and Lady Caroline Douglas was at last forced from it. Even Dr Warren, who must be strengthened as far as habit can operate against nature to endure such scenes, ran from this, convulsed with sorrow. If any extent of sympathy can lessen affliction, this family may find such relief; for perhaps no man was ever more generally beloved by all who had access to him than the earl of Guildford.

We may form an opinion of the estimation the celebrated university of Oxford entertained of their chancellor while living, by the very great honour they paid to his remains. About five o'clock in the afternoon of the 15th, the great bell at St Mary's church at Oxford rang out, which was a signal that the funeral procession had arrived in the environs of that city. The officers of the university, and the whole body of resident students, were previously assembled in Magdalen College, in order to pay some tribute to the memory of their deceased chancellor. They joined the procession at Magdalen Bridge, and paraded on foot before the herse up the high street to Carfax; from thence down the corn market to St Giles's church at the town's end, in a most solemn manner. Here they halted, and opening to the right and left, the herse and other carriages passed through, the whole university being uncovered. The herse and attendants then proceeded to Banbury, where his lordship's remains were deposited in the family vault.

NORTH Cape, the most northerly promontory in Europe, on the coast of Norway. E. Long. 21. 0. N. Lat. 78. 0.

NORTH Ferry, a small village, on the north side of the frith of Forth, at the Queen's Ferry passage. There was here formerly a chapel, served by the monks of Dunfermline, and endowed by Robert I. Near it are large whinstone quarries, which partly supply London with paving stones, and employ many vessels for the conveyance. "The granite (whinstone) (Mr Pennant says) lies in perpendicular strata, and above is a reddish earth, filled with micaceous friable nodules."

NORTH Foreland, a cape or promontory of Kent, in the isle of Thanet, four miles east of Margate. Between this and the South Foreland are the Downs, through which all ships pass that are bound to or from the west. E. Long. 1. 25. N. Lat. 51. 25.

NORTH-West Passage, a passage to the Pacific ocean through Hudson's bay or Davis's straits, and which hath been frequently attempted without success; notwithstanding which, many people are still of opinion that it is practicable.

The idea of a passage to the East Indies by the north pole, or through some opening near to it, was suggested as early as the year 1527. The person who had the honour to conceive this idea was Robert Thorne, a merchant of Bristol, who addressed two papers on the subject, the one to King Henry VIII. the other to Dr Ley, ambassador from that monarch to the emperor Charles V. To remove any objection to the undertaking, which might be drawn from the supposed danger, he insists, in his address to the king, upon the great advantages of constant daylight in the polar seas, and the probability of the climate being in those regions temperate during the summer months. In the paper addressed to Dr Ley, he observes that cosmographers may as probably be mistaken in the opinion which they entertain of the polar regions being impassable from extreme cold, as it has been found they were in supposing the countries under the line to be uninhabitable from excessive heat.

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The possibility of the passage was, in consequence of these addresses, very generally supposed; and in 1557, Sir Martin Forbisher sailed to 62° north latitude, where he discovered the straits which have since borne his name. In 1577, Barne, in a book entitled the *Regiment of the Sea*, mentions a north-west passage as one of the five ways to Cathay; and dwells on the mildness of the climate, which, from the constant presence of the sun during summer, he imagines must be found near the pole. In 1578, George Best, a gentleman who had been with Sir Martin Forbisher in his voyages of discovery, wrote a very ingenious discourse to prove all parts of the world habitable. It does not, however, appear that any voyage was undertaken, for the express purpose of attempting to sail to India in a north-west direction, till the year 1607, when Henry Hudson was sent, at the expence of some merchants in London to discover a passage by the north pole to Japan and China. He sailed from Gravesend on the 1st of May, and on the 21st of June fell in with the land to the westward, in latitude 73°, which he named *Hold-with-hope*. On the 27th he discovered Spitsbergen, and met with much ice. The highest latitude in which he made an observation was 80° 27′. See HUDSON.

In March 1609, Jones Poole was sent by Sir Thomas Smith, and the rest of the Muscovy Company, to make further discoveries towards the north pole. After great severity of weather, and much difficulty from ice, he made the south part of Spitsbergen on the 16th of May; and sailing along and sounding the coast, he made many accurate discoveries; but was not in that voyage able to proceed beyond 79° 50′. He was again employed (1611), in a small vessel called the *Elizabeth*, to attempt the north-west passage; but after surmounting numberless difficulties, and penetrating to 80° of latitude, he lost his ship at Spitsbergen. Two voyages, equally unsuccessful, were made in 1614 and 1615, by Baffin and Fotherby; the latter of whom concludes the account of his discoveries and dangers, with exhorting the company which employed him not to adventure more than 150l. or 200l. at most on yearly voyages to these seas.

Hitherto nothing had been done in this great undertaking but by private adventurers, fitted out for the double purpose of discovery and present advantage; and the polar regions were suffered to remain unexplored in that direction, from the year 1615 till 1773, when the earl of Sandwich, in consequence of an application which had been made to him by the Royal Society, laid before his majesty a proposal for an expedition to try how far navigation is practicable towards the north pole. Upon receiving this proposal, his majesty was pleased to direct that the voyage should be immediately undertaken, with every assistance that could contribute to its success. Accordingly, the Racehorse and Carcass bombs were fitted out for the purpose, and the command of the expedition given to Captain Phipps, now Lord Mulgrave. His Lordship's instructions were to proceed up to the pole, or as far towards it as possible, and as nearly upon a meridian as the ice or other obstructions should admit; and during the course of the voyage, to make such observations

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tions of every kind as might be useful to navigation, or tend to the promotion of natural knowledge. A very accurate account of this voyage was published by his Lordship in 1774. He had, by exerting all the powers of a skilful and intrepid seaman, forced his way, on the 1st of August, to 80° 37′; but could proceed no farther, as he was there opposed by one continued plain of smooth unbroken ice, bounded only by the horizon.

Many other attempts have been made to discover this passage, by sailing along the western coast of America; but hitherto none of them has been crowned with success. So early as 1579, Sir Francis Drake assured Queen Elizabeth that he had sailed some leagues up the straits of Anian (see ANIAN), and discovered New Albion, to the north of California; but the strait is now known to have no existence; and Drake's real discoveries were not improved. In 1638, King Charles I. sent Captain Luke Fox in one of his pinnaces to attempt the passage; but of his proceedings we know nothing, but that he reached Port Nelson in Hudson's bay, where he found some remains of former navigators. Next year Captain James was fitted out by the merchants of Bristol for the same purpose. James was one of the ablest navigators that ever sailed from England or any other country; and his voyages to the north were printed in 1633. After all the experiments he had made, he concluded that there was no such passage; or if there be, he affirmed that the discovery of it would not be attended with those advantages which are commonly expected. His reasons, however, for these opinions have been answered, and many subsequent attempts have been made to perform what he thought impossible. The arguments for a north-west passage were so plausible, that, in 1744, an act of parliament was passed to encourage the discovery of it. Among many others, Captain Cook attempted the discovery in vain, and thence adopted James's opinion. (See *COOKE's Discoveries*, N° 103.) This celebrated navigator, after having proceeded northwards to the western extremity of America, and ascertained the proximity of the two great continents of Asia and America, returned to the Sandwich islands, firmly persuaded of the impracticability of a passage in that hemisphere from the Atlantic into the Pacific ocean, either by an eastern or a western course.

Later voyagers, however, have pretended to detect some errors in Cooke's discoveries; and the author of a small tract, entitled *An authentic Statement of all the Facts relative to Nootka Sound*, goes a great way to make the discovery not yet hopeless. In his account of the expedition under the direction of Messrs Etches, he says, that "one of the first discoveries made by these ships was, that what was by the immortal Cook laid down as a continuation of the north-west continent of America, and lying between the northern latitudes of 48° and 57, is on the contrary an extensive cluster of unexplored islands inhabited by numerous tribes of friendly Indians, with whom a regular connexion was formed."

These islands they discovered, contrary to the assertion of Captain Cook, to conceal the opening of a vast inland sea, or archipelago, in all probability equal to the Mediterranean or Baltic seas, and dividing the great northern continent of America. The Princess Royal penetrated some hundred leagues among them, in a north-east course, to within 200 leagues of Hudson's house, but had not then an opportunity to explore the extreme termination of that archipelago, their commercial concerns obliging them to return to the China market; but the commanders had the strongest reasons to believe, had the time favoured their survey, that they should have been able to discover the long wished for passage between the Atlantic and South sea. They conceived, that should neither the inland arm of the sea through which the Princess Royal penetrated, nor a large strait named Sir Charles Middleton's about three degrees to the southward, be found to reach across the continent, yet that the land barrier must be very inconsiderable; and that at the extremity of this bay a practicable passage, either by rivers or lakes, will, by perseverance, be found terminating towards Hudson's bay.

The last attempt to discover this passage was made by Vancouver between the years 1790 and 1795; but the result of this voyage renders the existence of such a passage still more doubtful.

Upon the whole, however, it appears to us extremely doubtful whether there be such a passage; but it is much more likely to be discovered, if discovered at all, by the progressive advances of mercantile enterprise than by any immediate expedition undertaken for that purpose.

North-east Passage.

NORTH-East Passage, a passage to the East Indies along the northern coasts of Asia, which, like the former, hath frequently been attempted, but hitherto without success. The first attempt was made in 1553, by Sir Hugh Willoughby, who commanded three ships. He departed from the Thames and sailed to the North Cape, where one of his ships left him, and returned home. The other two ships being separated, Sir Hugh proceeded farther northward, and discovered that part of Greenland which the Dutch have since called *Spitzberg*; but the severity of the cold obliging him to return to the southward, he was forced, by bad weather, into the river Arzina, in Muscovite Lapland, where, not being able to come out, he was found the next spring frozen to death, with all his ship's company; having the notes of his voyage and his last will lying before him, whereby it appeared that he lived till January. But Richard Chancellor, in the third ship, with better success, in the meanwhile entered Wardhuys, where he waited some time for his companions to no purpose; uncertain whether they were lost, or driven farther by stress of weather. He held a council on what he should do; whether to return, or pursue his voyage. Whatever danger might be in the last, every one agreed to it, that they might not seem to have less courage than their captain. They therefore set sail, and in a few days found themselves in a sea where they could no longer perceive any night. This ship, wandering about, entered soon after into a large bay or gulf. Here they cast anchor, in sight of land; and while they were examining the coast, they discovered a fishing boat. Chancellor getting into his sloop, went towards it; but the fishermen took to flight. He followed, and, overtaking them, showed them such civilities as conciliated their affections to him; and they carried him to the place where now is the famous port of St Michael the Archangel. These people immediately spread through all the coasts an account of the arrival of those strangers; and people came from several parts to see them, and ask them questions. They, in their turn, examined the others, and found

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found that the country they were in was Russia, governed by the mighty emperor John Basilowitz. Chancellor from Archangel travelled on sledges to the Czar at Moscow; from whom, overjoyed at the prospect of opening a maritime commerce with Europe, he obtained privileges for the English merchants, and letters to King Edward VI. who was not, however, alive to receive them.

In 1585, Mr John Davis in two barks discovered Cape Desolation, which is supposed to be part of Greenland; and two years after advanced as far as Lat. 72°, where he discovered the strait which still bears his name. To enumerate all the attempts which have been made to discover a north-east passage, would swell the article to very little purpose. The English, Dutch, and Danes, have all attempted it without success. The last voyage from England for this purpose was made in 1676, under the patronage of the duke of York. That unfortunate prince, who was on all occasions earnest for the promotion of commerce, and the Lord Berkeley, &c. fitted out a ship, commanded by Captain Wood, for an attempt once more to find a north-east passage to India, accompanied with a ship of the king's. They were encouraged to this attempt, after it had been so long despaired of, by several new reports and reasonings: some of which seem not to have been very well grounded—As,

"1. On the coast of Corea, near Japan, whales had been found with English and Dutch harpoons sticking in them. This is no infallible proof that ships could get thither by a north-east passage, although whales might.

"2. That, 20 years before, some Dutchmen had sailed within one degree of the north pole, and found it temperate weather there: and that therefore William Barents, the Dutch navigator who wintered at Nova Zembla in the year 1596, should have sailed further to the north before turning eastward; in which case, said they, he would not have found so much obstruction from the ice.

"3. That two Dutch ships had lately sailed 300 leagues to the eastward of Nova Zembla; but their East India Company had stifled that design, as against their interest:—and such like other airy reports. But this attempt proved very unfortunate. They doubled the North Cape, and came among much ice and drift wood, in 76° of north latitude, steering to the coast of Nova Zembla, where the king's ship struck upon the rocks, and was soon beat to pieces; and Captain Wood returned home with an opinion, "that such a passage was utterly impracticable, and that Nova Zembla is a part of the continent of Greenland."

These passages, however, are not yet deemed impracticable by all. The count de Buffon holds it for certain, that there is a passage from Europe to China by the North sea. The reason why it has been so often attempted in vain, he thinks, is, that fear prevented the undertakers from keeping at a sufficient distance from land, and from approaching the pole, which they probably imagined to be an immense rock. Hence he affirms, that if any farther attempts be made to find a passage to China and Japan by the north seas, it will be necessary to keep at a distance from the land and the ice; to steer directly towards the pole; and to explore the most open seas, where unquestionably, says he, there is little or no ice. This opinion has been lately revived by the honourable Daines Barrington, who says, that if the passage be attempted by the pole itself, he has very little doubt of its being accomplished. See *North-Pole*.

North-east Passage.

NORTHAMPTON, a town in England, capital of a county of the same name, situated in W. Long. 0. 55. N. Lat. 52. 15. According to Camden, it was formerly called *North-afandon*, from its situation to the north of the river Nen, called anciently *Aufona*, by which and another lesser river it is almost enclosed. Dr Gibson says, that the ancient Saxon annals called both it and Southampton simply *Hamton*; and afterwards, to distinguish them, called the one, from its situation, *Southamton*, and the other *Northamton*; but never *North-afandon*. Though it does not appear to be a place of very great antiquity, nor to have emerged from obscurity till after the Conquest, it has sent members to parliament since the reign of Edward I. and being in the heart of the kingdom, several parliaments have been held at it. There was also a castle, and a church dedicated to St Andrew, built by Simon de Sancto Licio, commonly called *Senlcz*, the first earl of Northampton of that name. It is said to have been burnt down during the Danish depredations; but in the reign of St Edward it appears to have been a considerable place. It was besieged by the barons in their war with King John; at which time that military work called *Hunshill*, is supposed to have been raised. In the time of Henry III. it sided with the barons, when it was besieged and taken by the king. Here the bloody battle was fought in which Henry VI. was taken prisoner. It was entirely consumed by a most dreadful fire in 1675; yet, by the help of liberal contributions from all parts of the country, it hath so recovered itself, that it is now one of the neatest and best built towns of the kingdom. Among the public buildings which are all lofty, the most remarkable are the church called *All-hallows* (which stands at the meeting of four spacious streets), the sessions and assize house, and the George inn, which belongs to the poor of the town. A county hospital or infirmary has been lately built here, after the manner of those of Bath, London, Bristol, &c. It has a considerable manufacture of shoes and stockings; and its fairs are noted for horses both for draught and saddle; besides, it is a great thoroughfare for the north and west roads. It was formerly walled, and had seven churches within and two without. The horse market is reckoned to exceed all others in the kingdom, it being deemed the centre of all its horse markets and horse fairs, both for saddle and harness, and the chief rendezvous of the jockies both from York and London. Its principal manufacture is shoes, of which great numbers are sent beyond sea; and the next to that, stockings and lace, as we have hinted at above. It is the richer and more populous, by being a thoroughfare both in the north and west roads; but, being 80 miles from the sea, it can have no commerce by navigation. The walls of this town were above two miles in compass. It is supposed to contain about 1085 houses, and 5200 inhabitants. It had formerly a nunnery in the neighbouring meadows, with several other monasteries; and of its very old castle on the west side of the town, a small part of the ruins is still to be seen. Some discontented

scholars

Northamptonshire || North Rocks.

scholars came hither from Oxford and Cambridge, about the end of the reign of Henry III. and, with the king's leave, prosecuted their studies here academically for three years; during which there was the face of an university, till it was put a stop to by express prohibition, because it was a damage to both universities. The public horse races are on a neighbouring down, called *Pey-Leys*. In and about the town are abundance of cherry gardens. Within half a mile of the town is one of the crosses erected by King Edward I. in memory of his queen Eleanor, whose corpse was rested there in its way to Westminster. On the north side of the river, near that cross, many Roman coins have been ploughed up. At Guilesborough, north-west of Northampton, are to be seen the vestiges of a Roman camp, the situation of which is the more remarkable, as lying between the Nen and the Avon, the only pass from the north to the south parts of England not intercepted by any river. This camp was secured only by a single intrenchment, which was, however, very broad and deep.

NORTHAMPTONSHIRE, a county of England, is situated in the very heart of the kingdom: bounded on the east by the counties of Bedford and Huntingdon; on the south by those of Buckingham and Oxford; on the west by Warwickshire; and on the north by the counties of Leicester, Rutland, and Lincoln, which are separated from it by the Lesser Avon, and the Welland. Its greatest length is about 50 miles, its greatest breadth about 20, and its circumference about 130. It contains 330 parishes. There are in it one city, 11 market towns, 25,000 houses, and 131,757 inhabitants. Nine members are returned to parliament for this county, viz. two knights for the shire, two for the city of Peterborough, two for each of the towns of Northampton and Brockly, and one for Higham Ferrers. It lies in the midland circuit, and in the diocese of Peterborough. As this county is dry, well cultivated, free from marshes, except the fens about Peterborough, in the centre of the kingdom, and of course at a distance from the sea, it enjoys a very pure and wholesome air. In consequence of this it is very populous, and so full of towns and churches, that 30 spires or steeples may be seen in many places at one view; and even in the fens, the inhabitants seem to enjoy a good state of health, and to be little affected by the water which frequently overflows their grounds, especially in winter, but is never suffered to remain long upon it. Its soil is exceeding fertile both in corn and pasturage; but it labours under a scarcity of fuel, as it doth not produce much wood, and, by lying at a distance from the sea, cannot be easily supplied with coal. Its commodities, besides corn, are sheep, wool, black cattle, and saltpetre; and its manufactures are serges, tammies, shalloons, boots, and shoes. Besides many lesser brooks and streams, it is well watered by the rivers Nen, Welland, Ouse, and Lerm; the three first of which are large, and for the most part navigable.

NORTHAMPON, a county of North America, in Virginia, forming the south part of the peninsula on the eastern coast of Virginia.

NORTH ROCKS, (otherwise called *St Patrick's rocks*, from a seat of stone amongst them called *St Patrick's chair*, whence the rocks have taken this second name); situated in the harbour of Donaghadee, in the county of Down, and province of Ulster, in Ireland. From north to south they are about two thirds of a league, between which is clean good ground. But care must be taken of the south rock, on which many ships have perished: for it is overflowed by every tide, and no crew can save their lives if the wind blows high. This rock stands a full mile from the shore.

North Sea || Northumberland.

NORTH SEA. See *North SEA*.

NORTHERN LIGHTS, the same with AURORA BOREALIS, under which article we have given a copious account of this phenomenon, and of the supposed causes of it. Natural science, however, does not arrive at perfection at once, and it is well if it does so after trials repeated for years with care and accuracy. How far the causes that have been assigned for this appearance will account for it, or whether they will be able to remove all difficulties, it is not for us to determine; but it is the part of philosophers to hear all sides, and to attend with patient assiduity to every hypothesis, rejecting or receiving, as reason, after the strictest investigation, shall seem to favour the one side or the other. We shall here notice a hypothesis which Doctor Stearns, an American, formed, about the year 1788, to account for the appearances called *aurora borealis*, and *aurora australis*.

Doctor Stearns supposes that these phenomena originate from aqueous, nitrous, sulphureous, bituminous, and other exhalations, from the fumes of various kinds of earths or other minerals, vegetables, animals, fires, volcanoes, &c. These, he thinks, become rarefied, and being charged with electrical fluid, become specifically lighter than the circumambient air; hence, of course, they ascend; and being elevated to the upper regions of the air, and driven by the winds from warmer to colder climates, the cold makes them combine and stiffen. When they are afterwards agitated by different currents of air, they sparkle and crackle like the hairs of cats and other animals when stiffened with cold. This coruscation in quite cold atmospheres, and in those which are more temperate, appears in different positions in the horizon, zenith, or otherwise, according to the situation of the spectator, and the position of the elevated exhalations. The difference of colours the doctor supposes to arise from the different qualities of the articles combined, those of the most inflammable nature shining with the greatest lustre.

The doctor likewise tries to account for these lights not appearing, or but seldom appearing, in ancient times. The atmosphere, he thinks, was not impregnated with materials proper to produce them. He imagines that the increased consumption of fuel, in America in particular, the burning of volcanoes, and the approach of blazing stars, whose atmospheres have been so expanded by the sun's heat that part of them have fallen into the earth's atmosphere, and communicated to it new matter, have so changed and prepared our air, that whenever its consistence is proper, then, if the light of the sun and moon is not too powerful, the aurora borealis will appear.

NORTHUMBERLAND, the most northerly county of England, and formerly a distinct kingdom, is bounded on the north and west by the river Tweed, which divides it from Scotland, the Cheviot hills, and part of Cumberland; washed on the east by the German ocean; and separated from Durham on the south by the rivers Tyne and Derwent. This county, which gives

Northumberland.

gives the title of *duke* to a nobleman who married the daughter of Algernon duke of Somerset, whose mother was heiress of the Percy family, extends about 66 miles in length from north to south, and about 47 in breadth from east to west. It is remarkably populous, containing 12 market towns, 280 villages, and 460 parishes. The face of the country, especially towards the west, is roughened with huge mountains, the most remarkable of which are the Cheviot hills, and the high ridge called *Redesdale;* but the lands are level towards the sea side and the borders of Durham. The climate, like that of every other mountainous country in the neighbourhood of the sea, is moist and disagreeable: the air, however, is pure and healthy, as being well ventilated by breezes and strong gales of wind; and in winter mitigated by the warm vapours from the two seas, the Irish and the German ocean, between which it is situated. The soil varies in different parts of the county. Among the hills it is barren; though it affords good pasture for sheep, which cover those mountains. The low country, when properly cultivated, produces plenty of wheat, and all sorts of grain; and great part of it is laid out in meadow lands and rich enclosures. Northumberland is well watered with many rivers, rivulets, and fountains: its greatest rivers are the Tweed and the Tyne. The Tyne is composed of two streams called *South* and *North Tyne:* the first rises on the verge of Cumberland, near Alston moor; enters Northumberland, running north to Haltwhistle; then bends easterly, and receiving the two small rivers East and West Alon, unites above Hexham with the other branch, taking its rise at a mountain called *Fane-head* in the western part of the county, thence called *Tynedale;* is swelled in its course by the little river Shele; joins the Read near Billingham; and running in a direct line to the south-east, is united with the southern Tyne, forming a large river that washes Newcastle, and falls into the German ocean near Tynemouth.

In all probability the mountains of Northumberland contain lead ore and other mineralized metals in their bowels, as they in all respects resemble those parts of Wales and Scotland where lead mines have been found and prosecuted. Perhaps the inhabitants are diverted from inquiries of this nature, by the certain profits and constant employment they enjoy in working the coal pits, with which this county abounds. The city of London, and the greatest part of England, are supplied with fuel from these stores of Northumberland, which are inexhaustible, enrich the proprietors, and employ an incredible number of hands and shipping. About 658,858 chaldrons are annually shipped for London.

There are no natural woods of any consequence in this county; but many plantations belonging to the seats of noblemen and gentlemen, of which here is a great number. As for pot herbs, roots, salading, and every article of the kitchen garden and orchard, they are here raised in great plenty by the usual means of cultivation; as are also the fruits of more delicate flavour, such as the apricot, peach, and nectarine. The spontaneous fruits it produces in common with other parts of Great Britain, are the crab-apple, the sloe or bullace, the hazel nut, the acorn, hips, and haws, with the berries of the bramble, the juniper, wood strawberries, cranberries, and bilberries.

Northumberland raises a good number of excellent horses and black cattle, and affords pasture for numerous flocks of sheep; both the cattle and sheep are of a large breed, but the wool is coarser than that which the more southern counties produce. The hills and mountains abound with a variety of game, such as red deer, foxes, hares, rabbits, heathcock, grouse, partridge, quail, plover, teal, and woodcock: indeed, this is counted one of the best sporting counties in Great Britain. The sea and rivers are well stocked with fish; especially the Tweed, in which a vast number of salmon is caught and carried to Tynemouth, where being pickled, they are conveyed by sea to London, and sold under the name of *Newcastle salmon.*

The Northumbrians were anciently stigmatized as a savage, barbarous people, addicted to cruelty, and inured to rapine. The truth is, before the union of the two crowns of England and Scotland, the borderers on each side were extremely licentious and ungovernable, trained up to war from their infancy, and habituated to plunder by the mutual incursions made into each kingdom; incursions which neither truce nor treaty could totally prevent. People of a pacific disposition, who proposed to earn their livelihood by agriculture, would not on any terms remain in a country exposed to the first violence of a bold and desperate enemy; therefore the lands lay uncultivated, and in a great measure deserted by every body but lawless adventurers, who subsisted by theft and rapine. There was a tract 50 miles in length and six in breadth, between Berwick and Carlisle, known by the name of the *debateable land,* to which both nations laid claim, though it belonged to neither; and this was occupied by a set of banditti who plundered on each side, and what they stole in one kingdom, they sold openly in the other: nay, they were so dexterous in their occupation, that by means of hot bread applied to the horns of the cattle which they stole, they twisted them in such a manner, that, when the right owners saw them in the market, they did not know their own property. Wardens were appointed to guard the marches or borders in each kingdom; and these offices were always conferred on noblemen of the first character for influence, valour, and integrity. The English border was divided into three marches, called the *east, west,* and *middle marches;* the gentlemen of the country were constituted deputy wardens, who held march courts, regulated the watches, disciplined the militia, and took measures for assembling them in arms at the first alarm: but in the time of peace between the two nations, they were chiefly employed in suppressing the insolence and rapine of the borderers. Since the union of the crowns, however, Northumberland is totally changed, both with respect to the improvement of the lands, and the reformation of the inhabitants. The grounds, being now secure from incursion and insult, are settled by creditable farmers, and cultivated like other parts of the kingdom. As hostilities have long ceased, the people have forgotten the use of arms; and exercise themselves in the more eligible avocations of peace, in breeding sheep and cattle, manuring the grounds, working at the coal pits, and in different branches of commerce and manufacture. In their persons they are generally tall, strong, bold, hardy, and fresh coloured; and though less unpolished than their ancestors, not quite so civilized as their southern neighbours. The commonalty are well fed, lodged, and clothed; and all of them remarkably distinguished by a kind of *shibboleth* or *whurle*, being a particular way of pronouncing the letter *R*, as if they hawked it up from the windpipe, like the cawing of rooks. In other respects, the language they speak is an uncouth mixture of the English and Scottish dialects. There is no material distinction between the fashionable people of Northumberland and those of the same rank in other parts of the kingdom; the same form of education will produce the same effects in all countries. The gentlemen of Northumberland, however, are distinguished for their industry, knowledge of rural affairs, and hospitality. The number of inhabitants is reckoned 157,101; of houses 22,740.

A great number of Roman monuments have been found in this county; but the most remarkable curiosity of that kind consists in the remains of Hadrian's vallum and the wall of Severus. See *ADRIAN*, note (A), and *SEVERUS's Wall*.

The most noted towns in Northumberland, are Newcastle, Morpeth, Alnwick, Berwick, Hexham, and North Shields. It sends two members to parliament.

NORTHWICK, a small town of Cheshire, long celebrated for its rock salt and brine pits. The stratum of salt lies about 40 yards deep; and some of the pits are hollowed into the form of a temple. The descent is through a dome, the roof supported by rows of pillars about two yards thick, and several in height; and when illuminated with a sufficient number of candles, they make a most magnificent appearance. Above the salt is a bed of whitish clay (*Argilla cærula-cinerea*), used in making the Liverpool earthen ware; and in the same place is also dug a good deal of the gypsum, or plaster stone. The fossil salt is generally yellow, and semipellucid, sometimes debased with a dull greenish earth; and is often found, but in small quantities, quite clear and colourless. The town is situated near the river Dane, and is tolerably handsome: it has a market on Fridays. It is 20 miles north-east of Chester, and 173 north-west of London. W. Long. 2. 36. N. Lat. 53. 16.

NORTON, in Cheshire, a good modern alms-house, founded by P—y Brooke, Esq. on the site of a priory of canons regular of St Augustine, founded by William, son of Nigellus, A. D. 1135, who did not live to complete his design; for Eustace de Burgaville granted to Hugh de Catherine pasture for 100 sheep, in case he finished the church in all respects conformable to the intent of the founders. It was granted afterwards to R. Brooke, Esq.

NORTON'S SOUND, was discovered in Captain Cook's last voyage, and was so named in honour of Sir Fletcher Norton (Lord Grantley), a near relation of Mr afterwards Dr King. It extends as far as N. Lat. 64° 55'. There is no good station for ships, nor even a tolerable harbour in all the sound. Mr King, on his landing here, discerned many spacious valleys, with rivers flowing through them, well wooded, and bounded with hills of a moderate height. One of the rivers towards the north-west seemed to be considerable; and he was inclined to suppose, from its direction, that it discharged itself into the sea from the head of the bay. Some of his people, penetrating beyond this into the country, found the trees to be of a larger size the further they proceeded. E. Long. 197. 13. N. Lat. 64. 31.

NORWAY, a country of Europe (for the map see DENMARK), lying between the 57th and 72d degrees of north latitude, and between the 5th and 31st degrees of longitude east from London; extending in length about 1000 miles, in a direct line from Lindesnaes, in the diocese of Christiansand, to the North Cape, at the extremity of Finmark. Its breadth, from the frontiers of Sweden westward to Cape Statt, may amount to about 300 miles; but from thence the country becomes gradually narrower towards the north. On the south it is bounded by the Schagen rock, or Categate, the entrance into the Baltic; on the east it is divided from Sweden by a long ridge of high mountains; and on the west and north it is washed by the northern occean. In the southern part of Norway, the country is craggy, abrupt, and mountainous, diversified sometimes with fertile and even delightful spots. In these respects it resembles Switzerland: the prospects and the meteorological phenomena seem to be very similar. The range of the thermometer is of great extent; in the summer having risen to 88°, and in the winter fallen to —40°: in general it is between 80° and —22°.

Respecting the population of Norway it is difficult to attain to certainty. An author of some note (Coxe) seems to think it amounts to 750,000; but he appears to have over-rated it considerably.

The Norwegian peasants are free, well clothed, well lodged, spirited, active, frank, open, and undaunted. They are said to have a very considerable resemblance to the peasants of Switzerland. The soil is too thin for the plough: corn is therefore obtained from the neighbouring states; and the chief employment of the peasants of Norway is grazing. The following extract from Mr Coxe, being a description of the scene near Christiana, is not beside our purpose, and may not perhaps be disagreeable to our readers.

" As we approached Christiana, the country was more wild and hilly, but still very fertile and agreeable; and about two miles from the town we came to the top of a mountain, and burst upon as fine a view as ever I beheld. From the point on which we stood in raptures, the grounds laid out in rich enclosures, gradually sloped to the sea; below us appeared Christiana, situated at the extremity of an extensive and fertile valley, forming a semicircular bend along the shore of a most beautiful bay, which, being enclosed by hills, uplands, and forests, had the appearance of a large lake. Behind, before, and around, the inland mountains of Norway rose on mountains covered with dark forests of pines and fir, the inexhaustible riches of the north. The most distant summits were caped with eternal snow. From the glow of the atmosphere, the warmth of the weather, the variety of the productions, and the mild beauties of the adjacent scenery, I could scarcely believe that I was nearly in the 60th degree of northern latitude." *Coxe's Travels.*

The coast of Norway, extending above 300 leagues, is studded with a multitude of small islands, affording habitation to fishermen and pilots, and pasture to a few cattle. They form an infinite number of narrow channels, and a natural barrier of rocks, which renders Norway inaccessible to the naval power of its enemies.

Norway.

mies. Attempts of this kind are the more dangerous, as the ſhore is generally bold, ſteep, and impending; ſo that cloſe to the rocks the depth of the ſea amounts to 100, 200, or 300 fathoms. The perils of the north ſea are moreover increaſed by ſudden ſtorms, ſunk rocks, violent currents, and dreadful whirlpools. The moſt remarkable vortex on this coaſt is called *Moſkoe-ſtrom*, from the ſmall iſland Moſkoe, belonging to the diſtrict of Lofoden in the province of Nordland. In time of flood, the ſtream runs up between Lofoden and Moſkoe with the moſt boiſterous rapidity; but in its ebb to the ſea, it roars like a thouſand cataracts, ſo as to be heard at the diſtance of many leagues. The ſurface exhibits different vortices; and if in one of theſe any ſhip or veſſel is abſorbed, it is whirled down to the bottom, and daſhed in pieces againſt the rocks. Theſe violent whirlpools continue without intervals, except for a quarter of an hour, at high and low water, in calm weather; for the boiling gradually returns as the flood or ebb advances. When its fury is heightened by a ſtorm, no veſſel ought to venture within a league of it. Whales have been frequently abſorbed within the vortex, and howled and bellowed hideouſly in their fruitleſs endeavours to diſengage themſelves. A bear, in attempting to ſwim from Lofoden to Moſkoe, was once hurried into this whirlpool, from whence he ſtruggled in vain for deliverance, roaring ſo loud as to be heard on ſhore; but notwithſtanding all his efforts, he was borne down and deſtroyed. Large trees being abſorbed by the current are ſucked down, and riſe again all ſhattered into ſplinters. There are three vortices of the ſame kind near the iſlands of Ferroe.

Norway is divided into the four governments of Aggerhus, Bergen, Drontheim, and Wardhus, beſides that of Bahus, which is now ſubject to Sweden. The province of Aggerhus comprehends the ſouth-eaſt part of Norway, extending in length about 300 miles. Its chief towns are Chriſtiana, the ſee of a biſhop, ſuffragan to the metropolitan ſee of Drontheim, where the ſovereign court of juſtice is held, in preſence of the viceroy and the governor of the province; Aggerhus, about 15 miles to the ſouth-weſt of Chriſtiana; Frederickſhall or Frederickſtadt, in the ſiege of which Charles XII. of Sweden loſt his life; Saltzberg, Tonſberg, Alleen, Hammar, and Hollen.

The government of Bergen lies in the moſt ſoutherly and weſterly part of Norway, including the city of the ſame name, which is an epiſcopal ſee, and a place of conſiderable trade; and Staffhanger, ſituated in the bay of Buckenfior, about 80 miles to the ſouthward of Bergen. The third province, called *Drontheim* or *Trontheim*, extends about 500 miles along the coaſt; and is but thinly peopled. The chief town, Drontheim, ſeated on a little gulf at the mouth of the river Nider, is the only metropolitan ſee in Norway; and carries on a conſiderable trade in maſts, deals, tar, copper, and iron. Leetſtrand, Stronden, Scoerdale, Opdal, Romſdael, and Solendael, are likewiſe places of ſome traffic. The northern diviſion of Drontheim, called the *ſub-government of Salten*, comprehends the towns Melanger and Scheen. The province of Wardhus, extending to the North Cape, and including the iſlands, is divided into two parts; namely, Finmark and Norwegian Lapland. The chief town, which is very inconſiderable, ſtands upon an iſland called *Ward*, from whence the place and the government derive their name. The province of Bahus, though now yielded to the Swedes, is reckoned part of Norway, being a narrow tract of land, about 90 miles in length, lying on the coaſt of the Categate.

The great chain of Norway mountains, running from north to ſouth, called indifferently *Rudfield*, *Sudefield*, *Skarsfield*, and *Scoreberg*, is known in different parts by other appellations; ſuch as *Dofrefield*, *Lamsfield*, *Sagnifield*, *Filefield*, *Halnefield*, *Hardangerfield*, *Joklefield*, *Byglefield*, *Hicklefield*, and *Hangfield*. The height and breadth of this extenſive chain likewiſe vary in different parts. To paſs the mountain Hardanger, a man muſt travel about 70 Engliſh miles, whereas Filefield may be about 50 over. This laſt riſes about two miles and a half in perpendicular height; but Dofrefield is counted the higheſt mountain of Norway, if not of Europe. The river Drivane winds along the ſide of it in a ſerpentine courſe, ſo as to be met nine times by thoſe who travel the winter road to the other ſide of the chain. The bridges are thrown over roaring cataracts, and but indifferently faſtened to the ſteep rocks on either ſide; ſo that the whole exhibits a very dreadful appearance, ſufficient to deter the traveller from hazarding ſuch a dangerous paſſage; for which reaſon, people generally chooſe the road over Filefield, which is much more tedious. This, however, is the poſt road uſed by the king's carriages. The way is diſtinguiſhed by poſts fixed at the diſtance of 200 paces from each other, that, in ſnowy or dark weather, the traveller may not be bewildered. For the convenience of reſting and refreſhing, there are two mountain ſtoves or houſes maintained on Filefield, as well as upon other mountains, at the expence of the public, and furniſhed with fire, light, and kitchen utenſils. Nothing can be more diſmal and dreary than thoſe mountains covered with eternal ſnow, where neither houſe, tree, nor living creature is to be ſeen, but here and there a ſolitary rein deer, and perchance a few wandering Laplanders.

In travelling from Sweden to Nordenfields, there is only one way of avoiding this chain of mountains; and that is, where it is interrupted by a long deep valley, extending from Romſdale to Guldbrandſdale. In the year 1612, a body of 1000 Scots, commanded by Sinclair, and ſent over as auxiliaries to the Swedes, were put to the ſword in this defile, by the peaſants of Guldbrand, who never give quarter.

Beſides this chain, there is a great number of detached mountains over all the country, that form valleys and ridges, inhabited by the peaſants. Some of theſe are of incredible height, and others exhibit very remarkable appearances. In ſailing up Joering Creek on the left hand, the ſight is aſtoniſhed with a group of mountains, reſembling the proſpect of a city, with old Gothic towers and edifices. In the pariſh of Oerſkong is the high mountain Skopſhorn, the top of which repreſents the figure of a fortification, with regular walls and baſtions. In the diſtrict of Hilgeland appears a very high range of mountains, with ſeven pinnacles or creſts, known by the appellation of the *Seven Siſters*, diſcernible a great way off at ſea. To the ſouthward of this range, though in the ſame diſtrict, riſes the famous mountain *Torghatten*, ſo called becauſe the ſummit reſembles a man's head with a hat on, under which appears a ſingle eye, formed by an aperture through the mountain, Norway. mountain, 150 ells high, and 3000 ells in length. The ſun may be ſeen through this ſurpriſing cavity, which is paſſable by the foot of travellers. On the top of the mountain we find a reſervoir of water, as large as a moderate fiſh pond: in the lower part is a cavern, through which a line 400 fathoms in length, being let down, did not reach the bottom. At Herroe in Sundmoer is another cavern called *Dolſteen*, ſuppoſed to reach under the ſea to Scotland; which, however, is no more than an idle tradition. In the year 1750, two clergymen entered this ſubterranean cavity, and proceeded a conſiderable way, until they heard the ſea daſhing over their heads: the paſſage was as wide and high as an ordinary church, the ſides perpendicular, and the roof vaulted. They deſcended one flight of natural ſtairs; but arriving at another, they were afraid to penetrate farther: they had gone ſo far, however, that two candles were conſumed in their progreſs and return. A cavern of a very curious nature, ſerving as a conduit to a ſtream of water, penetrates through the ſides of the mountain Limur. In the diſtrict of Rake, in the neighbourhood of Frederickſhall, are three cavities in a rock; one of which is ſo deep, that a ſmall ſtone dropped down, does not reach the bottom in leſs than two minutes; and then the ſound it produces is pleaſant and melodious, not unlike the ſound of a bell.

The vaſt mountains and rugged rocks that deform the face of this country are productive of numberleſs inconveniences. They admit of little arable ground: they render the country in ſome parts impaſſable, and everywhere difficult to travellers: they afford ſhelter to wild beaſts, which come from their lurking holes, and make terrible havock among the flocks of cattle: they expoſe the ſheep and goats, as well as the peaſants, to daily accidents of falling over precipices: they occaſion ſudden torrents, and falls of ſnow, which deſcend with incredible impetuoſity, and often ſweep away the labours of the huſbandman; and they are ſubject to dreadful diſruptions, by which huge rocks are rent from their ſides, and, hurling down, overwhelm the plains below with inevitable ruin. The peaſants frequently build their houſes on the edge of a ſteep precipice, to which they muſt climb by ladders, at the hazard of their lives; and when a perſon dies, the corpſe muſt be let down with ropes, before it can be laid in the coffin. In winter the mail is often drawn up the ſides of ſteep mountains. Even in the king's road, travellers are expoſed to the frequent riſks of falling over thoſe dreadful rocks; for they are obliged to paſs over narrow pathways, without rails or riſing on the ſides, either ſhored up with rotten poſts, or ſuſpended by iron bolts faſtened in the mountains. In the narrow paſs of Naerce is a remarkable way of this kind, which, above 600 years ago, the famous King Surre cauſed to be made for the paſſage of his cavalry; and even this would have been found impaſſable by any other horſes than thoſe of Norway, which are uſed to climb the rocks like goats. Another very difficult and dangerous road is that between Shogſtadt and Vang-in-Volders, along the ſide of a ſteep mountain, in ſome places ſo narrow, that if two travellers on horſeback ſhould meet in the night, they would find it impracticable either to paſs each other, or turn back. In ſuch a caſe their lives could not be ſaved, unleſs one of them ſhould alight, and throw his horſe headlong into the lake below, and then cling to the rock, until the other could paſs. When a ſheep or goat makes a falſe ſtep to the projection of a rock, from whence it can neither aſcend nor deſcend, the owner hazards his own life to preſerve that of the animal. He directs himſelf to be lowered down from the top of the mountain, ſitting on a croſs ſtick, tied to the end of a long rope; and when he arrives at the place where the creature ſtands, he faſtens it to the ſame cord, and it is drawn up with himſelf. Perhaps the other end of the rope is held by one perſon only; and there are ſome inſtances in which the aſſiſtant has been dragged down by the weight of his friend, ſo that both have periſhed. When either man or beaſt has had the miſfortune to fall over very high precipices, they have not only been ſuffocated by the repercuſſion of the air, but their bodies have been always burſt before they reached the ground. Sometimes entire creſts of rocks, many fathoms in length and breadth, have fallen down at once, creating ſuch a violent agitation of the air, as ſeemed a prelude to the world's diſſolution. At Steenbroe in Laerdale, a ſtupendous maſs, larger than any caſtle in the univerſe, appears to have been ſevered and tumbled from the mountain in large, ſharp, and ragged fragments, through which the river roars with hideous bellowing. In the year 1731, a promontory on Sundmoer, called *Rammersfield*, that hung over Nordal Creek, ſuddenly gave way, and plunged into the water; which ſwelled to ſuch a degree, that the church of Strand, though half a league on the other ſide of the bank, was overflowed: the creek, however, was not filled up; on the contrary the fiſhermen declare they find no difference in the depth, which is ſaid to exceed 900 fathoms.

The remarkable rivers of Norway are theſe: The Nied, iſſuing from Tydalen, on the borders of Sweden, runs weſtward into the lake Selboe; and afterwards, turning to the northward, paſſes by the city of Drontheim, to which it anciently gave the name of *Nideros* and *Nidroſia*: Sule Elv, that deſcending from Sulefield, runs with a rapid courſe through Nordale into the ſea: Gulen, which riſes near Sſarsfield in the north; and running 20 leagues weſtward, through Aalen, Hlotaalen, Storen, and Meihuus, diſcharges itſelf into the ſea, about a league to the weſt of Drontheim. In the year 1344, this river buried itſelf under ground: from whence it again burſt forth with ſuch violence, that the earth and ſtones thrown up by the eruption filled the valley, and formed a dam; which, however, was ſoon broken and waſhed away by the force of the water. Divers churches, 48 farm houſes, with 250 perſons, were deſtroyed on this occaſion.—Otteroen, a large river, taking its riſe from the mountain Agde, runs about 30 leagues through Seeterdale and Eſie, and diſembogues itſelf into the cataract of Wiland. The river Syre riſes near the mountain Lang, and winds its courſe through the vale of Syre into the lake of Lunde in the dioceſe of Chriſtianſand; thence it continues its way to the ſea, into which it diſcharges itſelf through a narrow ſtrait formed by two rocks. This contraction augments its impetuoſity, ſo that it ſhoots like an arrow into the ſea, in which it produces a very great agitation. Nid and Sheen are two conſiderable rivers, iſſuing out of Tillemark. Their water-falls have been diverted, with infinite labour, by canals and paſſages cut through the rocks, for the convenience of floating down the timber. Tyreford or Dramme, is in the neighbourhood of Honifoſſe;

Norway. nifoffe, joined by two rivers from Oedale and Hadeland, and difembogues itfelf into the fea near Bragnefs. Loven rifes in the higheft part of Nummedal, and runs through Konfberg to the fea near Laurwig. Glaamen is the largeft river of Norway, diftinguifhed by the name of *Stor Elvin*, or the *great river*. It derives its origin from the mountain Dofre, from whence it winds all along the plains of Oefterdale and Soloe; then joins the Vorme, another confiderable river rifing out of Mioes and Guldbrandfdale. Thefe being joined, traverfe the lake Oeyern; and thence iffuing, run on to Sarp near Frederickftadt.

Norway abounds with frefh-water lakes; the principal of which are Ryfvand in Nordland, Snaafen, Selboe, the Greater and Leffer Mioes, Slirevand, Sperdille, Rand, Veftn, Saren, Modum, Lund, Norfoe, Huidfoe, Farifvand, and Oeyevand: all thefe are well ftocked with fifh, and navigable for large veffels. Wars have been formerly carried on upon thefe inland feas; in fome of which are fmall floating iflands, or parcels of earth, with trees on them, feparated from the main land, and probably preferved in compact maffes by the roots of trees, fhrubs, and grafs, interwoven in the foil. In the year 1702, the family feat of Borge, near Frederickftadt, being a noble edifice, with lofty towers and battlements, fuddenly funk into an abyfs 100 fathoms deep, which was inftantaneoufly filled by a piece of water 300 ells in length and about half as broad. Fourteen perfons, with 200 head of cattle, perifhed in this cataftrophe, which was occafioned by the river Glaamen precipitating itfelf down a water-fall near Sarp, and undermining the foundation. Of all the water-falls in Norway this of Sarp is the moft dangerous for its height and rapidity. The current drives 17 mills; and roars with fuch violence, that the water, being dafhed and comminuted among the rocks, rifes in the form of rain, where a beautiful rainbow may be always feen when the fun fhines. In ancient times this cataract was made ufe of for the execution of traitors and other malefactors: they were thrown down alive, that they might be dafhed in pieces on the points of rocks, and die in a dreadful commotion, analogous to thofe they had endeavoured to excite in the community.

Great part of Norway is covered with forefts of wood, which conftitute the principal article of commerce in this country. They chiefly confift of fir and pine, for which great fums are received from foreigners, who export an immenfe number of mafts, beams, planks, and boards. Befides, an incredible quantity is confumed at home in building houfes, fhips, bridges, piles, moles, and fences; over and above the vaft demand for charcoal to the founderies, and fuel for domeftic ufes.—Nay, in fome places, the trees are felled for no other purpofe but to clear the ground and to be burned into afhes for manure. A good quantity of timber is yearly exported to Scotland and Spain: but this is inconfiderable when compared to the vaft exports from Drammen, Frederickfhall or Frederickftadt, Chriftiana, Skeen, Arendal, Chriftianfand, Chriftian's Bay, and Drontheim. The mafts and large beams are floated down the rivers, and the reft is divided into boards at the faw mills. Thefe works fupply a vaft number of families with a comfortable fubfiftence.—A tenth part of all fawed timber belongs to his Danifh majefty, and makes a confiderable branch of his revenue. The forefts in Norway are fo vaft and thick, that the people feem to think there can never be a fcarcity of wood, efpecially as the foil is peculiarly adapted for the production of timber: they therefore deftroy it with a wafteful hand; infomuch that more wood rots in Norway than is burned in the whole kingdom of Denmark. The beft timber grows in the provinces of Saltan, Helleland, Romfdale, Guldbrandfdale, Oefterdale, Soloe, Valders, Hallingdale, Sognifiord, Tellemark, and the lordfhip of Nedenes.

The climate of Norway is very different in different parts of the kingdom. At Bergen the winter is fo moderate, that the feas are always open and practicable both to mariners and fifhermen, except in creeks and bays, that reach far up into the country towards Filefield, when the keen north-eaft wind blows from the land. On the eaft fide of Norway, from the frontiers of Sweden to Filefield, the cold generally fets in about the middle of October with great feverity, and lafts till the middle of April; during which interval the waters are frozen to a very confiderable thicknefs, and the face of the country is covered with fnow. In the year 1719, 7500 Swedes, who intended to attack Drontheim, perifhed in the fnow on the mountain of Ruden or Tydel, which feparates Jempteland in Sweden from the diocefe of Drontheim. A company of 200 Norwegian fledgemen under Major Emahus, found them all frozen to death on the ridge of the mountain, where they had been furprifed by a ftorm accompanied with fnow, hail, and extreme cold. Some of thefe unhappy victims appeared fitting, fome lying, and others kneeling in a pofture of praying. They had cut in pieces their mufkets, and burned the little wood they afforded.—The generals Labarre and Zoega loft their lives; and of the whole corps, confifting originally of 10,000, no more than 2500 furvived this dreadful cataftrophe.

The cold is ftill more intenfe in that part of Norway called *Finmark*, fituated in the frigid zone near the polar circle. But if the winter is generally cold, the fummer is often exceffively hot in Norway. The rays of the fun are reverberated from the fides of the mountains fo as to render the weather clofe and fultry in the valleys; befides, the fun's abfence below the horizon is fo fhort, that the atmofphere and mountains have not time to cool. The heat is fo great, that vegetation is remarkably quick. Barley is fown, grows, ripens, and is reaped, in the fpace of fix weeks or two months. The longeft day at Bergen confifts of 19 hours; the fun rifing at half an hour after two, and fetting at half an hour after nine. The fhorteft day does not exceed fix hours; for the fun rifes at nine in the morning, and fets at three in the afternoon.—In the beginning of the year the daylight increafes with remarkable celerity; and, at the approach of winter, decreafes in the fame proportion. In fummer one may read and write at midnight by the light of the fky. Chriftian V. while he refided at Drontheim, ufed to fup at midnight without candles. In the diftrict of Tromfen, at the extremity of Norway, the fun is continually in view at midfummer. It is feen to circulate day and night round the north pole, contracting its orbit, and then gradually enlarging it, until at length it leaves the horizon. In the depth of winter, therefore, it is for fome weeks invifible; and all the light perceived at noon is a faint glimmering for about an hour and a half, proceeding from the reflection of the fun's rays from the higheft

mountains.

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mountains. But the inhabitants of these provinces are supplied with other lights that enable them to follow their employments in the open air. The sky being generally serene, the moonshine is remarkably bright, and, being reflected from the mountains, illuminates the valleys. They are also assisted by the aurora borealis, which is very frequent in the northern parts of Europe.

The air of Norway is generally pure and salubrious. On the sea coasts, indeed, it is rendered moist by vapours and exhalations: but in the midland parts of the country, towards the mountains, the climate is so dry, that meal may be kept for many years without being worm-eaten or damaged in the least. The inhabitants have no idea of sickness, except what is occasioned by excesses. It is said, that in the vale of Guldbrand the inhabitants live to such extreme old age, that they become weary of life, and cause themselves to be removed to a less salubrious climate, whereby they may have a chance of dying the sooner. In consumptions, however, the moist air on the sea side is found to be most agreeable to the lungs in respiration. Norway, being a mountainous country intersected by creeks, abounding with lakes, rivers, and snow, must be subject to frequent rains; and from sudden thaws the inhabitants are sometimes exposed to terrible disasters. Vast masses of snow falling from precipices overwhelm men, cattle, boats, houses, nay even whole villages. About two centuries ago, a whole parish was covered and destroyed by an immense mass of snow; and several domestic utensils, as sciffars, knives, and basons, have been at different times brought to light by a rivulet that runs under the snow, which has been gradually hardened and increased by repeated frosts and annual accessions.

The winds that chiefly prevail on the western coast are those that blow from the south; whereas, on the other side of Filefield, the winds that produce and continue the hard frosts are always northerly. In the summer, there is a kind of regular trade-wind on the coast of Bergen. In the forenoon the sea begins to be cooled with a westerly breeze, which continues till midnight. Then the land breeze begins from the east, and blows till about ten in the morning. The coast is likewise subject to sudden squalls and storms. Hurricanes sometimes rise at sea; and in these latitudes the phenomenon called a *water-spout* is not uncommon. One of these in the neighbourhood of Ferro is said to have sucked up with the water some lasts of herrings, which were afterwards dropped on Kolter, a mountain 1200 feet high.

The fresh water of Norway is not very light or pure; but on the contrary, is generally turbid, and deposites a sediment of adventitious matter, being sometimes impregnated with ochre and particles of iron.—Nevertheless it is agreeable to the taste, and remarkably salubrious; as appears from the good health of the common people, who drink little or no other liquor.

The soil of Norway varies in different places according to the situation of rock or valley. The mountains, here, as in every other country, are bare and barren; but the earth washed down from them by the rains enriches and fertilizes the valleys. In these the soil generally consists of black mould, sand, loam, chalk, and gravel, lying over one another in unequal strata, and sometimes in three or four successions: the mould that lies uppermost is very fine and mellow, and fit to nourish all sorts of vegetables. There is also clay found in different parts of this kingdom, of which the inhabitants begin to make earthen ware; but bricks and tiles are not used in building. The face of the country is in many places deformed by large swamps and marshes, very dangerous to the traveller. Near Leessoe in the diocese of Christiansand, a wooden causeway is extended near a mile over a morass; and if a horse or any other animal should make a false step, he will sink at once into the abyss, never to rise again.

In a cold country like Norway, roughened with rocks and mountains, interspersed with bogs, and covered with forests, we cannot expect to find agriculture in perfection. The ploughed lands, in respect to mountains, woods, meadows, and wastes, do not exceed the proportion of 1 to 80; so that the whole country does not produce corn to maintain above half the number of its inhabitants. The peasants are discouraged from the practice of husbandry by the frequency of accidents that seem peculiar to the climate. Even in the fruitful provinces of Guldbrandsdale, Oesterdale, and Soloer, as well as in the other places, when the corn appears in the most flourishing condition, the whole hope of the harvest is sometimes destroyed in one night by a sudden frost that nips the blade and extinguishes the vegetation. The kingdom is moreover visited by some unfavourable years, in which the sun seems to have lost his genial power; the vegetables are stunted; the trees bud and bloom, yet bear no fruit; and the grain, though it rises, will yet produce nothing but empty ears and straw. This calamity, however, rarely occurs; and in general the cultivated parts of Norway yield plentiful crops of excellent rye, barley, and oats. The most fruitful provinces are Nordland, Inderbarre, and Numedale, in the diocese of Drontheim; Sognifiord and Vaas, in that of Bergen; Jedderen, Ryefylsk, Raabygdelag, and the lordship of Nedenes, in the diocese of Christiansand; Hedemark in the diocese of Aggerhus; Hadeland, Toten, Romerige, Ringerige, and Guldbrandsdale: these territories not only produce grain enough for their own consumption, but likewise support their neighbours, and even supply part of Sweden.—Pease are likewise propagated in this country, together with wheat, buckwheat, hops, hemp, and flax, but not to any considerable advantage. The meadows are well stored with pasturage for sheep and cattle, and the fields are productive of those vegetables which are common in other northern countries. Within these 50 years the people of Norway have bestowed some attention on the culture of gardens, which in former times was so neglected, that the cities and towns were supplied with leeks, cabbage, and roots, from England and Holland. At present, however, the Norwegians raise their own culinary and garden roots and vegetables, which thrive there as well as in any other country. The scurvy being a disease that prevails along the sea coast, Nature has scattered upon it a variety of herbs efficacious in the cure of that distemper; such as angelica, rose-wort, gentian, cresses, trefoil, sorrel, scurvy-grass, and a plant called *erich's grass*, that grows in great plenty on the islands of Nordland: from whence the people of the continent fetch away boat loads of it, to be preserved in barrels as a succedaneum for cabbage. There are also a few noxious vegetables little known in any country but Norway.

In

Norway. In Guldbrandſdale is a ſpecies of graſs called *ſelfnape;* the root of which is ſo poiſonous, that any beaſt which eats of it dies immediately, the belly burſting; nay, the carnivorous fowls that prey upon the carcaſs of the beaſt meet with the ſame fate: children have been more than once poiſoned by this root, which nevertheleſs is ſometimes uſed externally as an amulet for arthritic diſorders. Another vegetable pernicious to the cattle is the *Gramen oſſifragum Norwegienſe,* which is ſaid to mollify the bones of the cattle which feed upon it. Among the noxious plants of Norway we may alſo reckon the igle-glaſs, fatal to ſheep and goats; the tour-graſs, which affects horſes and cows with a ſort of lethargy; and the plant torboe, or hiſte-ſpring, which produces nearly the ſame effect on horſes, but is not at all prejudicial to cows, ſheep, or any ruminating animals. The herb turte, not unlike angelica, operates nearly in the ſame manner: yet the bears are ſaid to feed upon it with peculiar reliſh; and when their hair begins to fall off by feeding upon this plant, they cure themſelves by eating the fleſh of animals.

The common fruit trees thrive tolerably well in Norway, the inhabitants of which have plenty of cherries, apples, and pears. Some kinds of plums attain maturity; which is ſeldom the caſe with grapes, apricots, and peaches. But even the apples and pears that ripen here are ſummer fruit; that which grows till the winter ſeldom coming to perfection. Great variety of agreeable berries is produced in different parts of this kingdom; ſuch as the hagebar, a kind of ſloes; an infuſion of which in wine makes a pleaſant cooling liquor; juniper berries, corinths red and white, ſoelbar or ſunberries, raſpberries, gooſeberries, blackberries, ſtrawberries, &c. with many other ſpecies that ſeem to be natives of Norway and Sweden. Among thoſe are the tranæbar, the produce of the myrtillus repens, red and auſtere, found in the ſpring in perfection under the ſnow, and much reliſhed by the reindeer; crakebeer, reſembling bilberries, deemed a powerful antiſcorbutic; agerbeer, larger and blacker than bilberries, of a pleaſant acid, ripened by cold, and uſed as cherries for an infuſion in wine; and finally tyltebeer, a red pleaſant berry growing on a ſhort ſtem, with leaves like thoſe of box; they are plucked off by handfuls, and ſent to Denmark to be preſerved for the table, where they are eaten by way of deſſert.

Of the trees that grow wild in Norway, the principal are the fir and the pine. The firſt yield an annual revenue of 1,000,000 of rixdollars, if we include the advantages reſulting from the ſaw mills and the maſts; one of which laſt has been known to ſell for 200 rixdollars. The red fir tree, which grows on the mountains, is ſo rich in turpentine as to be almoſt incorruptible. Some of the houſes belonging to the Norway peaſants, built of this timber, are ſuppoſed to be above 400 years ſtanding. In Guldbrandſdale the houſe is ſtill to be ſeen ſtanding in which King Olaf lodged five nights, above 700 years ago, when he travelled round the kingdom to convert the people to the Chriſtian faith. Even 100 years after the trunk of the fir tree has been cut down, the peaſants burn the roots for tar, which is a very profitable commodity. In the fens, the reſin of the fir tree is by nature transformed into a ſubſtance which may be called *Norway frankincenſe.* The buds or pine apples of this tree, boiled in ſtale beer, make an excellent medicine for the ſcurvy; leſs unpleaſant to the taſte, though as efficacious, as tar-water. The pine tree is more tall and beautiful than the fir, though inferior to it in ſtrength and quality; for which reaſon the planks of it are ſold at an inferior price, and the peaſants waſte it without remorſe. Norway likewiſe produces ſome foreſts of oak, which is found to be excellent for ſhip-building. Here alſo grow plenty of elm trees; the bark of which, being powdered, is boiled up with other food to fatten hogs, and even mixed by the poor among their meal; alſo the aſh, from which the peaſants diſtil a balſam uſed in certain diſorders, and which is uſed both externally and internally. Many other trees flouriſh in this country, an enumeration of which would prove too tedious. Hazels grow here in ſuch abundance, that 100 tons of the nuts are annually exported from Bergen alone.

A great diverſity of ſtones is found in Norway, ſome of which are of a ſurpriſing figure. Several mountains conſiſt chiefly of a brown pebble, which decays with age; nay, it ſometimes diſſolves, and drops into the ſea, and the cement being thus looſened, a terrible diſruption enſues. In ſome places the gray and black pebbles are intermixed with iron, copper, lead, ſilver, and gold. The ground in certain diſtricts is covered with the fragments of rocks that have been precipitated from the ſummits of mountains, and broken by their fall into innumerable ſhivers. Between 20 and 30 years ago, in the neighbourhood of Bergen, a man was ſuddenly overwhelmed with ſuch a maſs, which formed a kind of vault around him. In this dreadful tomb he remained alive for ſeveral weeks. By his loud cries the place of his confinement was diſcovered: but it was found impoſſible to remove the huge ſtones by which he was incloſed. All that his friends could do for him was, to lower down meat and drink through ſome crevices; but at length the ſtones fell in, and cruſhed him to death.

In Norway are inexhauſtible quarries of excellent marble, black, white, blue, gray, and variegated; together with ſome detached pieces of alabaſter, ſeveral kinds of ſpar, chalk-ſtone, cement-ſtone, ſand-ſtone, mill-ſtone, baking-ſtone, ſlate, talc, magnets, and ſwine-ſtone, a production natural to Norway and Sweden, of a brown colour, fetid ſmell, in texture reſembling cryſtal, and deriving its name from a ſuppoſed efficacy in curing a diſtemper incident to ſwine. Here alſo is found the amianthus or ſtone-flax, of which incombuſtible cloth may be made. Norway, however, affords no flints, but plenty of pyrites or quartz, beautiful cryſtals, granites, amethyſts, agate, thunder-ſtones, and eagle-ſtones. Gold has formerly been found in a ſmall quantity in the dioceſe of Chriſtianſand, and coined into ducats. There is at preſent a very conſiderable ſilver mine wrought at Kongſberg on the account and at the riſk of his Daniſh majeſty: the ore is ſurpriſingly rich, but interrupted in ſuch a manner, that the vein is often loſt. Many maſſes of pure ſilver have been found; and, among the reſt, one piece weighing 560 pounds, preſerved in the royal muſeum at Copenhagen. Such is the richneſs of theſe mines, that the annual produce amounts in value to a ton and a half in gold. About 5000 people are daily employed, and earn their ſubſiſtence, in thoſe ſtupenduous

works

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works (A). Other ſilver mines are proſecuted at Jarlſberg, but not to the ſame advantage; and here the ore is mixed with lead and copper. In many parts of this country copper mines have been diſcovered; but the principal, and perhaps the richeſt in all Europe, is at Roraas, about 100 Engliſh miles from Drontheim. This work yields annually about 1100 ſhip pounds of pure copper: the founderies belonging to it conſume yearly about 14,000 laſts of coal, and 500 fathoms of wood. The next in importance is the copper work at Lykken, about 20 miles from Drontheim. A third mine is carried on at Indſet or Quickne, at the diſtance of 30 miles from the ſame place; and here they precipitate the copper from its menſtruum, by means of iron. There is a fourth copper work at Silboe, about 30 miles diſtant from Drontheim, though the leaſt conſiderable of the four. Other copper mines of leſs note are worked in different parts of the kingdom. Iron is ſtill in greater plenty, and was the firſt metal wrought in this country. Many hundred thouſand quintals are annually exported, chiefly in bars, and part of it in ſtoves, pots, kettles, and cannon: the national profit ariſing from this metal is eſtimated at 300,000 rixdollars. There is a ſpecies called *moor-iron*, found in large lumps among the moraſſes: of this the peaſants make their own domeſtic tools and utenſils, ſuch as knives, ſcythes, and axes. The lead found mixed in the ſilver ore is an article of ſmall importance in Norway; yet ſome mines of this metal have been lately opened in the diſtrict of Soloer by the proprietors of the copper work at Oudal. A vitriol work has been begun near Kongſberg: the mines yield great plenty of ſulphur; which, however, the Norwegians will not take the trouble to melt and depurate, becauſe immenſe quantities are found at a cheaper rate in the iſland of Iceland. Alum is found between the ſlate flakes near Chriſtiana in ſuch plenty, that works have been ſet up for refining this mineral, though they have not yet brought it to any degree of tranſparency. His Daniſh majeſty has eſtabliſhed ſalt works in the peninſula of Valoe, about ſix Engliſh miles from Tonſberg, where this mineral is extracted in large quantities from the ſea water.

Beſides the animals common to other countries, Norway is ſaid to contain many of the uncommon and dubious kind; ſuch as the kraken, mermaid, ſea ſerpent, &c. See theſe articles.

Many Daniſh, Engliſh, Scotch, Dutch, and German families have now ſettled in Norway; and indeed form no inconſiderable part of the trading people: but the original inhabitants are the deſcendants of thoſe ferocious Normanni, who haraſſed almoſt all the coaſts of Europe with piratical armaments in the 8th, 9th, and 10th centuries.

"Our firſt certain knowledge of the inhabitants of this country (ſays Pennant *) was from the deſolation they brought on the ſouthern nations by their piratical invaſions. Their country had before that period the name of *Nortmanland*, and the inhabitants *Nortmans*, a title which included other adjacent people. Great Britain and Ireland were ravaged by them in 845; and they continued their invaſion till they effected the conqueſt of England, under their leader Canute the Great. They went up the Seine as far as Paris, burnt the town, and forced its weak monarch to purchaſe their abſence at the price of fourteen thouſand marks. They plundered Spain, and at length carried their excurſions through the Mediterranean to Italy, and even into Sicily. They uſed narrow veſſels, like their anceſtors the Sitones; and, beſides oars, added the improvement of two ſails; and victualled them with ſalted proviſions, biſcuit, cheeſe, and beer. Their ſhips were at firſt ſmall; but in after times they were large enough to hold 100 or 120 men. But the multitude of veſſels was amazing. The fleet of Harold Blaatand conſiſted of 700. A hundred thouſand of theſe ſavages have at once ſailed from Scandinavia, ſo juſtly ſtyled *Officina gentium, aut certè velut vagina nationum*. Probably neceſſity, more than ambition, cauſed them to diſcharge their country of its exuberant numbers. Multitudes were deſtroyed; but multitudes remained, and peopled more favourable climates.

"Their king, Olaus, was a convert to Chriſtianity in 994; Bernard an Engliſhman had the honour of baptizing him, when Olaus happened to touch at one of the Scilly iſlands. He plundered with great ſpirit during ſeveral years; and in 1006 received the crown of martyrdom from his pagan ſubjects. But religious zeal firſt gave the reſt of Europe a knowledge of their country and the ſweets of its commerce. The Hanſe towns poured in their miſſionaries, and reaped a temporal harveſt. By the year 1204, the merchants obtained from the wiſe prince Suer every encouragement to commerce; and by that means introduced wealth and civilization into his barren kingdom. England by every method cheriſhed the advantages reſulting from an intercourſe with Norway, and Bergen was the emporium. Henry III. in 1217, entered into a league with its monarch Haquin; by which both princes ſtipulated for free acceſs for their ſubjects into their reſpective kingdoms, free trade, and ſecurity to their perſons. In 1269, Henry entered into another treaty with Magnus; in which it was agreed, that no goods ſhould be exported from either kingdom except they had been paid for; and there is, beſides a humane proviſion on both ſides, for the ſecurity of the perſons and effects of the ſubjects who ſhould ſuffer ſhipwreck on their ſeveral coaſts."

The inhabitants now ſpeak the ſame language that is uſed in Denmark, through their original tongue is the dialect now ſpoken in Iceland. They profeſs the Lutheran religion, under an archbiſhop eſtabliſhed at Drontheim,

* Arct. Zool.

(A) Mr Coxe tells us, that he viſited thoſe mines. They formerly, he ſays, produced annually 70,000l. but at preſent yield little more than 50,000l. The expences generally exceed the profits; and government gains only by the number of miners employed. The mines of cobalt, and the preparation of Pruſſian blue, are much more productive. The latter goes through 270 hands, and the number of men employed is 365. It is ſuppoſed, that, at this period (1793), it may produce to government a profit of 16,000l. a-year.

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Drontheim, with four ſuffragans; namely, of Bergen, Staffanger, Hammer, and Chriſtiana. By the union of Calmar, the two kingdoms of Norway and Denmark were united under one monarch; and then the people of both nations enjoyed conſiderable privileges: but the Daniſh government ſoon became abſolute; and Norway was ruled deſpotically by a viceroy, who reſided in the capital, and preſided in the ſupreme court, to which appeals were made from the ſubordinate courts of judicature. A great change has, however, taken place ſince the preſent amiable and accompliſhed prince of Denmark had part of the government; and more may be expected from his virtue and aſſiduity when the power ſhall come wholly into his own hands.

The Norwegians are generally well formed, tall, ſturdy, and robuſt, brave, hardy, honeſt, hoſpitable, and ingenious; yet ſavage, raſh, quarrelſome, and litigious. The ſame character will nearly ſuit the inhabitants of every mountainous country in the northern climates. Their women are well ſhaped, tall, comely, remarkably fair, and obliging. The nobility of Norway have been chiefly removed by the kings of Denmark, in order to prevent faction and oppoſition to the court; or are long ago degenerated into the rank of peaſants: ſome families, however, have been lately raiſed to that dignity. Every freeholder in Norway enjoys the right of primogeniture and power of redemption; and it is very uſual to ſee a peaſant inhabiting the ſame houſe which has been poſſeſſed 400 years by his anceſtors. The *odels-gads*, or freehold, cannot be alienated by ſale or otherwiſe from the right heir, called *odels-mand:* if he is not able to redeem the eſtate, he declares his incapacity every 10th year at the ſeſſions; and if he, or his heirs to the third generation, ſhould acquire wealth enough for that purpoſe, the poſſeſſor *pro tempore* muſt reſign his poſſeſſion.

The mountaineers acquire ſurpriſing ſtrength and dexterity by hard living, cold, laborious exerciſe, climbing rocks, ſkating on the ſnow, and handling arms, which they carry from their youth to defend themſelves againſt the wild beaſts of the foreſt. Thoſe who dwell in the maritime parts of Norway exerciſe the employments of fiſhing and navigation, and become very expert mariners.

The peaſants of Norway never employ any handicraftſmen for neceſſaries to themſelves and families: they are their own hatters, ſhoemakers, taylors, tanners, weavers, carpenters, ſmiths, and joiners: they are even expert at ſhip-building; and ſome of them make excellent violins But their general turn is for carving in wood, which they execute in a ſurpriſing manner with a common knife of their own forging. They are taught in their youth to wreſtle, ride, ſwim, ſkate, climb, ſhoot, and forge iron. Their amuſements conſiſt in making verſes, blowing the horn, or playing upon a kind of guitar, and the violin: this laſt kind of muſic they perform even at funerals. The Norwegians have evinced their valour and fidelity in a thouſand different inſtances. The country was always diſtracted by inteſtine quarrels, which raged from generation to generation. Even the farmers ſtand upon their punctilio, and challenge one another to ſingle combat with their knives. On ſuch occaſions they hook themſelves together by their belts, and fight until one of them is killed or mortally wounded. At weddings and public feaſts they drink to intoxication, quarrel, fight, and murder generally enſues. The very common people are likewiſe paſſionate, ambitious of glory and independence, and vain of their pedigree. The nobility and merchants of Norway fare ſumptuouſly; but the peaſant lives with the utmoſt temperance and frugality, except at feſtivals: his common bread is made of oatmeal, rolled into broad thin cakes, like thoſe uſed in Scotland. In time of ſcarcity, they boil, dry, and grind the bark of the fir tree into a kind of flour which they mix with oat meal; the bark of the elm tree is uſed in the ſame manner. In thoſe parts where a fiſhery is carried on, they knead the roes of cod with their oat meal. Of theſe laſt, mixed with barley meal, they make haſty pudding and ſoup, enriched with a pickled herring or ſalted mackarel. Freſh fiſh they have in plenty on the ſea coaſt. They hunt and eat grouſe, partridge, hare, red deer, and reindeer. They kill cows, ſheep, and goats, for their winter ſtock: theſe they pickle, or ſmoke, or dry for uſe. They make cheeſe of their milk, and a liquor called *ſyre* of their ſour whey: this they commonly drink mixed with water; but they provide a ſtore of ſtrong ale for Chriſtmas, weddings, chriſtenings, and other entertainments. From their temperance and exerciſe, joined to the purity and elaſticity of their air, they enjoy good health, and often attain to a ſurpriſing degree of longevity. Nothing is more common than to ſee a hearty Norwegian turned of 100. In the year 1733, four couples danced before his Daniſh majeſty at Frederickſhall: their ages, when joined, exceeded 800 years. Neverthele*ſ*s the Norwegians are ſubject to various diſeaſes; ſuch as the ſcab, the leproſy, the ſcurvy, the catarrh, the rheumatiſm, gout, and epilepſy. The dreſs of the Norway peaſants conſiſts of a wide looſe jacket made of coarſe cloth, with waiſtcoat and breeches of the ſame. Their heads are covered with flapped hats, or caps ornamented with ribbons. They wear ſhoes without outer ſoles, and in the winter leathern buſkins. They have likewiſe ſnow ſhoes and long ſkates, with which they travel at a great pace, either on the land or ice. There is a corps of ſoldiers thus accoutred, who can outmarch the ſwifteſt horſes. The Norwegian peaſant never wears a neckcloth, except on extraordinary occaſions: he opens his neck and breaſt to the weather, and lets the ſnow beat into his boſom. His body is girt round with a broad leathern belt, adorned with braſs plates, from which depends a braſs chain that ſuſtains a large knife, gimlet, and other tackle The women are dreſſed in cloſe laced jackets, having leathern girdles decorated with ornaments of ſilver. They likewiſe wear ſilver chains round their necks, to the ends of which are fixed gilt medals. Their caps and handkerchiefs are almoſt covered with ſmall plates of ſilver, braſs, and tin, large rings, and buttons. A maiden bride appears with her hair plaited, and, together with her clothes, hung full of ſuch jingling trinkets.

The churches, public edifices, and many private houſes in Norway, are built of ſtone: but the people in general live in wooden houſes, made of the trunks of fir and pine tree laid upon each other, and joined by mortiſes at the corners. Theſe are counted more dry, warm, and healthy, than ſtone or brick buildings. In the whole dioceſe of Bergen, one hardly ſees a farm houſe with a chimney or window: they are generally lighted by a ſquare hole in the top of the houſe, which lets in the light, and lets out the ſmoke. In ſummer this

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this hole is left quite open: in the winter, it is covered with what they call a *ſiau;* that is the membrane of ſome animal, ſtretched upon a wooden frame that fits the hole, and tranſmits the rays of light. It is fixed or removed with a long pole occaſionally. Every perſon that enters the houſe, upon buſineſs or courtſhip, takes hold of this pole, according to ancient cuſtom. The ceiling is about eight feet high in the middle; and, being arched like a cupola, the ſmoke of the fire underneath rolls about, until it finds a vent at the hole, which is called *liur*. Under this opening ſtands a thick table with benches, and a high ſeat at the upper end for the maſter of the family: he has likewiſe a ſmall cupboard for his own uſe, in which he locks up his moſt valuable effects. The boards of the roof are coated with the bark of the birch trees, which is counted incorruptible: this again is covered with turf, which yields a good crop of graſs for goats and ſheep, and is often mowed as hay by the farmer.

The Norwegians carry on a conſiderable trade with foreign nations. The duty on the produce of their own country exported, amounts annually to 100,000 rixdollars. Theſe commodities are, copper wrought and unwrought: iron caſt into cannon, ſtoves, and pots, or forged into bars; lead, in ſmall quantity; maſts, timber, deal boards, planks, marble, millſtones, herring, cod, ling, ſalmon, lobſters, flounders, cow hides, goat ſkins, ſeal ſkins, the furs of bears, wolves, foxes, beavers, ermines, martens, &c. down, feathers, butter, tallow, train oil, tar, juniper and other ſorts of berries, and nuts; ſalt, alum, glaſs, vitriol, and pot aſhes. All other commodities and articles of luxury the Norwegians import from different nations. The nature of the ground does not admit of much improvement in agriculture: nevertheleſs, the farmers are not deficient in induſtry and ſkill to drain marſhes, and render the ground arable and fit for paſture. Many are employed in grazing and breeding cattle: but a much greater number is engaged in felling wood, floating timber, burning charcoal, and extracting tar from the roots of the trees which have been cut down in the ſilver, copper, and iron mines; in the navigation and fiſhery. A conſiderable number of people earn a comfortable livelihood by hunting, ſhooting, and bird-catching. Every individual is at liberty to purſue the game, eſpecially in the mountains and commons: therefore every peaſant is expert in the uſe of fire arms; and there are excellent markſmen among the mountains, who make uſe of the bow to kill thoſe animals, whoſe ſkins, being valuable, would be damaged by the ſhot of fire arms.

Norway can produce above 14,000 excellent ſeamen. The army of this country amounts to 30,000 effective men; and the annual revenue exceeds 800,000 rixdollars.

NORWAY Rat. See MUS, MAMMALIA *Index*.

NORWICH, the capital of the county of Norfolk in England, ſituated in E. Long. 1. 26. N. Lat. 52. 40. It is ſuppoſed to have had its name, which ſignifies "a caſtle to the north," from its ſituation in reſpect of Caſtor, the ancient Venta Icenorum, three or four miles to the ſouth of it, out of whoſe ruins it ſeems to have riſen. In its infancy, in the reign of Etheldred, it was plundered and burnt by Sueno the Dane, when he invaded England with a great army. Afterwards it recovered; and in the reign of Edward the Confeſſor was a conſiderable place, having 1320 burghers. But it ſuffered again much in the reign of William I. by being the ſeat of a civil war, which Ralph earl of the Eaſt Angles raiſed againſt that king. So much was it impaired by the ſiege it then underwent, that there were ſcarce 560 burghers left in it, as appears from Doomſday book. From that time forward it began by little and little to recover, eſpecially after Biſhop Herbert tranſlated the epiſcopal ſee hither from Thetford in the reign of William Rufus in 1096; and built a beautiful cathedral, of which he himſelf laid the firſt ſtone, with this inſcription, *Dominus Herbertus poſuit primam lapidem, in nomine Patris, Filii, et Spiritus Sancti*, Amen, i. e. "Lord (Biſhop) Herbert laid the firſt ſtone, in the name of the Father, Son, and Holy Ghoſt;" and by a licenſe from Pope Paſchal, declared it the mother church of Norfolk and Suffolk. After this, as Malmſbury has it, it became a town famous for merchandiſe and the number of inhabitants. Yet it was miſerably haraſſed in the reign of Henry II. by Hugh Bigod earl of Norfolk, who was an adherent of Henry's ſon, called the *junior king*. In the time of Edward I. it was walled round by the citizens, who had preſented a petition to parliament for liberty to do it. Henry IV. allowed them, inſtead of bailiffs, which they had before, to elect a mayor yearly, and made the city a county of itſelf. In the year 1348, near 58,000 perſons were carried off by the plague; and in 1505, the city was almoſt conſumed by fire. For the flouriſhing ſtate to which the city is now arrived, they are much indebted to the Flemings, who fled hither from the tyranny of the duke of Alva and the inquiſition, and taught them the manufacture of thoſe ſtriped and flowered damaſks, camblets, druggets, black and white crape, for which the place is now ſo noted, and which have been computed to yield ſometimes 200,000l. a-year. In the year 1583, the citizens, by the help of an engine, conveyed water through pipes to the higheſt parts of the city, which is pleaſantly ſeated along the ſide of a hill, extending a mile and a half in length from north to ſouth; but the breadth is much leſs, and it contracts itſelf by degrees towards the ſouth. It is now one of the moſt conſiderable cities in Britain for wealth, populouſneſs, neat buildings, beautiful churches, (of which it had once 58, but now only 36), and the induſtry and civility of the inhabitants. The cathedral is a very venerable ſtructure, with a curious roof, adorned with the hiſtory of the Bible in little images, carved to the life, and a lofty ſteeple 105 yards high. The wall of flint ſtone, beautified with 40 towers and 12 gates, finiſhed in 1309, is now much decayed. The city, though there is a great deal of waſte ground within the walls, was computed, about 60 years ago, to contain 8000 houſes and 50,000 inhabitants. Beſides the cathedral already mentioned, the moſt remarkable buildings are, the duke of Norfolk's houſe, one of the largeſt in England; the caſtle, which is now the county gaol, and ſtands in the heart of the city, with a deep moat round it, over which is a bridge of one very large arch; the town hall; the guild hall, formerly the church belonging to the monaſtery of Black Friars; the houſe of correction; the ſhire houſe, where the aſſizes are held; a lofty market croſs, built after the manner of a piazza; the biſhop's palace; the king's ſchool, founded by Edward VI. the boys of which are nominated by the mayor for the time being, with the conſent

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Norwich. consent of the majority of aldermen. There having been formerly many thatched houses, an order was made, that all houses that should hereafter be built should be covered with tiles. The city is interspersed with gardens, orchards, and trees, which make it both pleasant and healthful. It has four hospitals, in which a great number of old men and women, boys and girls, are maintained; and a dozen charity schools. Here are two churches for the Dutch and French Flemings; who have particular privileges, and are very numerous. Some of the churches are thatched, and all of them crusted with flint stone curiously cut; which is the more wonderful, as Norwich stands in a clay country, and has no flint within 20 miles of it. It is now governed by a mayor, recorder, steward, two sheriffs, 24 aldermen, 60 common council, with a town clerk, sword-bearer, and other inferior officers. The mayor is chosen on May-day by the freemen, and sworn in on the Tuesday before Midsummer-eve. The sheriffs are also chosen annually, on the first Tuesday in August, one by the freemen, the other by the aldermen, and sworn in on Michaelmas day. The freemen of the several wards choose each their alderman. The common council is chosen in Midlent. The mayor is a justice of the peace and quorum, during his year (as are also the recorder and steward) within the city and liberties; and after his mayoralty, he is a justice during life. The trade and manufactures of the city are very considerable. At Yarmouth they export large quantities of their manufactures, most of which are sent to London; and import a great deal of wine, coal, fish, oil, &c. All the city and country round are employed in the worsted manufacture, brought hither, as already observed, by the Flemings, in which they not only consume the wool of their own county, in spinning, weaving, &c. but use many thousand packs of yarn which they receive from other parts of England, as far as Yorkshire and Westmoreland. There are eight wardens of the weavers chosen annually, and sworn to take care that there be no frauds committed in spinning, weaving, or dying the stuffs. It is computed that there are not less than 120,000 people employed in and about the city in the silk and woollen manufactures. Their markets are thought to be the greatest in England, and furnished with a surprising plenty and variety of goods and provisions. At a small village to the north of the city, called *St Faith's*, not less than 40,000 head of Scotch cattle are said to be yearly bought up by the Norfolk graziers, and fattened in their meadows and marshes. Its markets are on Wednesday, Friday, and Saturday. It has a great number of fairs, sends two members to parliament, and gives the title of earl to the duke of Gordon.

Few cities or towns seem to have suffered more than Norwich has done at various periods, and few seem to have felt it less; for though quite burnt down by Sueno as above, it was of considerable consequence in Edward the Confessor's time; nor did it long feel the evils of the insurrection and siege in William the Conqueror's time, for it was rebuilt in Stephen's reign, and made a corporation.

The city of Norwich has long been famous for its manufactures; which are not, in the opinion of some, at present in so flourishing a state as formerly. In addition to the manufacture of camblets, druggets, and crapes, it is also remarkable for baize, serges, shalloons, stockings, and woollen cloths.

The inhabitants of Norwich are generally so employed in their manufactures within doors, that the city has the appearance of being deserted, except on Sundays and holidays, when the streets swarm with people.

Caster, near Norwich, was the Venta Icenorum, or capital city of the Iceni, the broken walls of which contain a square of about 30 acres. In those walls may still be perceived the remains of four gates and a tower. Several Roman urns, coins, and other relicks of antiquity, have been found in this place.

Nose. NOSE, the organ of smell. See ANATOMY. The uses of the nose are, its giving us the sense of smelling; its serving in the great office of respiration, and in modelling the voice; in receiving the abundant humours from the eyes, and in adding to the beauty of the face.

The nose was by the augurs particularly attended to in forming conjectures concerning future good or ill success. The tingling of the right or left side of it, for instance, was thought to have different significations as it happened to different sexes, or persons in different conditions.

In Tartary, the greatest beauties are those who have the least noses. Ruybrock mentions the wife of the great Jenghiz Khan as a celebrated beauty, because she had only two holes for a nose. The Crim Tartars break the noses of their children while young, as thinking it a great piece of folly to have their noses stand before their eyes. In most other countries, China excepted, great noses are an honour.

In what the beauty of the nose consists, different nations have different opinions: and the following reflections of Sir Joshua Reynolds on this subject, are perhaps the most philosophical account of the beauty of form that is to be found in any language. "I suppose (says Sir Joshua) it will be easily granted, that no man can judge whether any animal be beautiful in its kind, or deformed, who has seen only one of that species: that is as conclusive in regard to the human figure; so that if a man born blind was to recover his sight, and the most beautiful woman was brought before him, he could not determine whether she was handsome or not; nor, if the most beautiful and most deformed were produced, could he any better determine to which he should give the preference, having seen only those two. To distinguish beauty, then, implies the having seen many individuals of that species. If it is asked, how is more skill acquired by the observation of greater numbers? I answer, that, in consequence of having seen many, the power is acquired, even without seeking after it, of distinguishing between accidental blemishes and excrescences, which are continually varying the surface of Nature's works, and the invariable general form which Nature most frequently produces, and always seems to intend in her productions. *Idler* vol. ii.

"Thus amongst the blades of grass or leaves of the same tree, though no two can be found exactly alike, yet the general form is invariable: a naturalist, before he chose one as a sample, would examine many, since, if he took the first that occurred, it might have, by

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accident or otherwise, ſuch a form as that it would ſcarce be known to belong to that ſpecies; he ſelects, as the painter does, the moſt beautiful, that is, the moſt general form of nature.

"Every ſpecies of the animal as well as the vegetable creation may be ſaid to have a fixed or determinate form, towards which nature is continually inclining, like various lines terminating in the centre; or it may be compared to pendulums vibrating in different directions over one central point; and as they all croſs the centre, though only one paſſes through any other point, ſo it will be found that perfect beauty is oftener produced by nature than deformity: I do not mean than deformity in general, but than any one kind of deformity. To inſtance in a particular part of a feature: the line that forms the ridge of the noſe is beautiful when it is ſtraight; this then is the central form, which is oftener found than either concave, convex, or any other irregular form that ſhall be propoſed. As we are then more accuſtomed to beauty than deformity, we may conclude that to be the reaſon why we approve and admire it, as we approve and admire cuſtoms and faſhions of dreſs for no other reaſon than that we are uſed to them; ſo that though habit and cuſtom cannot be ſaid to be the cauſe of beauty, it is certainly the cauſe of our liking it: and I have no doubt, but that if we were more uſed to deformity than beauty, deformity would then loſe the idea now annexed to it, and take that of beauty; as if the whole world ſhould agree that *yes* and *no* ſhould change their meanings, *yes* would then deny, and *no* would affirm.

"Whoever undertakes to proceed further in this argument, and endeavours to fix a general criterion of beauty reſpecting different ſpecies, or to ſhow why one ſpecies is more beautiful than another, it will be required from him firſt to prove that one ſpecies is really more beautiful than another. That we prefer one to the other, and with very good reaſon, will be readily granted; but it does not follow from thence that we think it a more beautiful form; for we have no criterion of form by which to determine our judgement. He who ſays a ſwan is more beautiful than a dove, means little more than that he has more pleaſure in ſeeing a ſwan than a dove, either from the ſtatelineſs of its motions, or its being a more rare bird; and he who gives the preference to the dove, does it from ſome aſſociation of ideas of innocence that he always annexes to the dove; but if he pretends to defend the preference he gives to one or the other, by endeavouring to prove that this more beautiful form proceeds from a particular gradation of magnitude, undulation of a curve, or direction of a line, or whatever other conceit of his imagination he ſhall fix on as a criterion of form, he will be continually contradicting himſelf, and find at laſt that the great mother Nature will not be ſubjected to ſuch narrow rules. Among the various reaſons why we prefer one part of her works to another, the moſt general, I believe, is habit and cuſtom: cuſtom makes, in a certain ſenſe, white black, and black white; it is cuſtom alone determines our preference of the colour of the Europeans to the Æthiopians; and they, for the ſame reaſon, prefer their own colour to ours. I ſuppoſe nobody will doubt, if one of their painters was to paint the goddeſs of beauty, but that he would repreſent her black, with thick lips, flat noſe, and wooly hair; and it ſeems to me he would act very unnaturally if he did not; for by what criterion will any one diſpute the propriety of his idea? We indeed ſay, that the form and colour of the European is preferable to that of the Ethiopian: but I know of no other reaſon we have for it, but that we are more accuſtomed to it. It is abſurd to ſay, that beauty is poſſeſſed of attractive powers, which irreſiſtibly ſeize the correſponding mind with love and admiration, ſince that argument is equally concluſive in favour of the white and the black philoſopher.

Noſe ‖ Noſtoch.

"The black and white nations muſt, in reſpect of beauty, be conſidered as of different kinds, at leaſt a different ſpecies of the ſame kind; from one of which to the other, as I obſerved, no inference can be drawn.

"Novelty is ſaid to be one of the cauſes of beauty: that novelty is a very ſufficient reaſon why we ſhould admire, is not denied; but becauſe it is uncommon, is it therefore beautiful? The beauty that is produced by colour, as when we prefer one bird to another, though of the ſame form, on account of its colour, has nothing to do with this argument, which reaches only to form. I have here conſidered the word beauty as being properly applied to form alone. There is a neceſſity of fixing this confined ſenſe; for there can be no argument, if the ſenſe of the word is extended to every thing that is approved. A roſe may as well be ſaid to be beautiful, becauſe it has a fine ſmell, as a bird becauſe of its colour. When we apply the word *beauty*, we do not mean always by it a more beautiful form, but ſomething valuable on account of its rarity, uſefulneſs, colour, or any other property. A horſe is ſaid to be a beautiful animal; but had a horſe as few good qualities as a tortoiſe, I do not imagine that he would be then eſteemed beautiful.

"A fitneſs to the end propoſed is ſaid to be another cauſe of beauty; but ſuppoſing we were proper judges of what form is the moſt proper in an animal to conſtitute ſtrength or ſwiftneſs, we always determine concerning its beauty before we exert our underſtanding to judge of its fitneſs.

"From what has been ſaid, it may be inferred, that the works of nature, if we compare one ſpecies with another, are all equally beautiful; and that preference is given from cuſtom, or ſome aſſociation of ideas; and that in creatures of the ſame ſpecies, beauty is the medium or centre of all various forms. See the article Beauty, towards the end.

NOSOLOGY, is a Greek word ſignifying a diſcourſe or treatiſe of diſeaſes; otherwiſe called *pathology*.

The importance of a comprehenſive and accurate noſology has been long and generally allowed. Baglivi, Boerhaave, Gorter, Gaubius, and Sydenham, have expreſſed their deſire of a work of this kind, the great object of which is to fix pathognomonics to every diſeaſe; or in which all diſeaſes are diſpoſed into certain claſſes, orders, and genera, founded on diſtinctions taken from the ſymptoms only, without regard to remote or proximate cauſes. See Medicine.

NOSTOCH, shot stars; *tremella noſtoc*, (Lin. Spec. Plant Dillenius de Muſcis, tab. 10. fig. 14. Flor. Danica, tab. 885. fig. 1.); *tremella inteſtinalis vel meſenterica*, Noſtoch. *meſenterica*, (Lin. Spec. Plant. Dillen. de Muſ. tab. 10. fig. 16. Flor. Danic. tab. 885. fig. 2.)

A writer in the Gentleman's Magazine gives this account of it: "The ſubſtance in queſtion is not unfrequent in England, nor in all other parts of Europe, after rains, both in ſpring and autumn. Very large ſpots of it are ſeen in gravelly ſoils, and particularly on the tops of hills, and on open downs, and often it is found on gravel walks.

"It is met with in ſome of the old authors, under the name of *noſtoch*, as in Paracelſus and others; and the alchemiſts fancied there was ſomething wonderful in it, and that it would afford a menſtruum for gold. Noſtoch is ſaid to be a word ſynonymous to *Jaculum alicujus ſtellæ, vel potius ejus repurgatione dejectum quid in terram; flos aëris; fragmentum nimbi;* as this ſubſtance was believed to fall from the ſky with the meteors that we often ſee, and call *falling-ſtars.* Hence the country people in Sweden have called it *ſky-fall;* and in England it is known by the name of *witches butter*, in common with ſome of the gelatinous liverworts.

"Paracelſus, Helmont, and others, ranked it with the *terniabin*, or manna, and thought it dropped, as that did, from heaven. It is deſcribed, and the chemical analyſis thereof given, by M. Geoffroy, in the Paris Memoirs for 1708, and is there ſaid to yield, beſides an acid phlegm, a portion of concrete volatile ſalt and ſome fixed ſalt. The diſtilled water from it was believed by ſome to poſſeſs ſingular virtues, in allaying pains of the joints; but there is certainly no room to attribute any extraordinary qualities to it.

"Since the days of Paracelſus it has been conſidered as a vegetable production; but the botaniſts have had difficulty to aſſign its place or genus in their ſeveral ſyſtems. Our own countryman, Dr Merret, ſeems to have been among the firſt authors who ranked it among vegetables, and he calls it *Lichen humiditate intumeſcens, ſiccitate evaneſcens* (Pin. page. 71.) Others have retained it among the plants of that genus to this day; as does the celebrated Dr Haller, in his *Hiſtoria Stirp. Helvetiæ*, who calls it *Lichen gelatinoſus, plicatus, undulatus; laciniis criſpatis, granuloſis*, N° 2041, as there are ſeveral of the liverworts that have a gelatinous texture and appearance; though they differ much from the noſtoch, in not being ſo inſtantly dried up. It was put into Ray's Synopſis, by Dr Dillenius, under the name of *Ulva terreſtris pinguis et fugax*, p. 64.; but he afterwards changed that name for *tremella*, in his *Hiſtoria Muſcorum*, where he calls it *tremella terreſtris ſinuoſa pinguis et fugax*, p. 52. tab. 10. f. 14, and reduces the lavers to the ſame genus. Micheli, an Italian botaniſt, famous for his attention to the Cryptogamia claſs of plants, makes it a *fungus*, as Magnol and Dr Moriſon had done before him, and deſcribes and figures it, in his *Nova Plantarum Genera*, under the name of *Linkia terreſtris gelatinoſa, membranacea, vulgatiſſima*, p. 126. t. 67. f. 1. He deſcribes the ſeeds as lying in the form of little ſtrings of beads, coiled up within the plant, or rather in the folds thereof, and only to be diſcovered by the microſcope. Linnæus mentions it, firſt under the name of *Byſſus gelatinoſa fugax terreſtris*, in his *Flora Lapponica*, N° 530; but he afterwards adopted Dillenius's term, though he does not make it a laver. Linnæus has called it, in all his ſubſequent works, *tremella (noſtoc) plicata, undulata*, under which name it ſtands in his *Species Plantarum*, p. 1157, and in Hudſon's *Flora Anglica*, p. 463, as alſo in a numerous ſet of other authors who follow his ſyſtem."

Another writer in the ſame work gives this account of it. "This ſubſtance is very rarely ſeen between the middle of April and the month of October. It is moſt frequently to be found in the high paſture lands, where the ground is inclined to wet, and on the moors and commons in the north of England. The time we always meet with it is after a very wet night, when the air in the morning ſuddenly clears up, and a ſharp froſt enſues. The frogs that then happen to be out are immediately ſeized by the froſt, and turned into this jelly-like ſubſtance. For as I have had occaſion ſometimes to go out very early, I have found ſeveral parts of the frog not yet diſſolved among the jelly, ſuch as feet, legs, and thighs, yet in a little time afterwards the change was fully completed. The quantity of jelly produced from one ſingle frog is almoſt beyond belief, even to five or ſix times its bulk when in its natural ſtate.

"I communicated this diſcovery to an acquaintance, who has ſince had frequent opportunities of obſerving and examining this production; and we are fully aſſured, that, whatever opinion the learned may have of it, it certainly proceeds from the above-mentioned cauſe wherever found.

"Moſt people that I have converſed with on the ſubject, are of opinion that this jelly falls from the ſtars, or out of the higher regions of the air; which notion, however abſurd, many are credulous enough to believe."

Naturaliſts had for ſome years begun to doubt whether theſe gelatinous ſubſtances were of a vegetable or animal nature, when at length Mr J. Platt of Oxford, in a letter printed in the Gentleman's Magazine for 1776, page 402, threw ſuch light on the ſubject as to us, at leaſt, is perfectly ſatisfactory.

"From a child I remember ſeeing the meteors ſhooting in the air, which appearance, by my comrades, was called *ſtar-ſhooting*, believing the ſtars no larger than their apparent magnitude. This jelly-like ſubſtance mentioned in your magazine, was believed to be the droſs of theſe meteors, and took the name of *ſtar-ſhot*, which paſſed for certain with me till I had arrived at the age of 24, when I was engaged in buſineſs that required my frequently paſſing over both meadows and paſture-grounds, where in ſpring and autumn I ſaw many portions of this ſuppoſed alga or noſtoch, but never more than one or two contiguous, moſtly near the water, when the meadows were or had been juſt before flooded. My conjectures were various, until I ſaw a crow pecking of ſomething in a field, which I heard to cry; when turning my horſe to the place, I found a frog of the common ſize, which the crow (of the carrion kind) would ſoon have killed and gorged, had I not diſturbed her, and chaſed her away.

"About this time I found in a meadow the bowels of a frog indigeſted, and compact as the chitterlings of a calf or pig; but white as the paper I write upon, though not tranſlucid. I took it up, and placed it in a paper expoſed to the air; leaving it in ſome graſs where I found it, till my return that way in three days time, Noſtradamus.

time, when I ſaw it changed to that tremulous jelly-like ſubſtance, the alga or ſtar-ſhot. I was much pleaſed with this diſcovery, and took it home in my pocket wrapped in a paper, where I ſhowed it to a ſociety of young perſons of which I was a member, who agreed with my ſentiments of its being the indigeſtible part of a frog diſgorged by ſome bird of prey.

"To corroborate my ſentiments of this alga being the bowels of a frog, I luckily ſaw ſome of it lying by the ſide of a brook, where I lighted and took it up, and to my great ſurpriſe found attached to the jelly the head, heart, liver, and one leg of the frog, which had been (I preſume) diſgorged by ſome carrion crow, who frequented the flooded grounds to pick up worms and other vermine. There was alſo ſome of it found on an apple tree at Wyſton Magna, near Leiceſter, where I then lived, which, no doubt, was diſgorged by ſome owl."

Dr Darwin, in his Poem on the Loves of the Plants, is of the ſame opinion with Mr Platt, that theſe gelatinous ſubſtances are of an animal nature, and that the different appearances they put on are owing to various circumſtances, viz. the different birds who feed on frogs, the quantity they devour at a time, and the ſtate of digeſtion before they are voided.

NOSTRADAMUS, Michel, an able phyſician and a celebrated aſtrologer, was a Provençal, and deſcended of a noble family, and born Dec. 14. 1503, at St Remy, in the dioceſe of Avignon. By his grandfather he was initiated in the ſtudy of the mathematics. He afterwards completed his courſes of humanity and philoſophy at Avignon; and, going thence to Montpelier, he there applied himſelf to phyſic, till being forced away by the plague in 1525, he took his route towards Thoulouſe, and paſſed on till he came to Bourdeaux. This courſe held him five years, during which he undertook the cure of all ſuch patients as were willing to put themſelves under his care. After this he returned to Montpelier, and was created doctor of his faculty in 1529, and then reviſited the ſame places where he had practiſed phyſic before. At Agen he contracted an acquaintance with Julius Cæſar Scaliger, which induced him to make ſome ſtay in that town, and there he entered into matrimony; but having buried his wife, and two children which ſhe brought him, he quitted Agen after a reſidence of about four years. He returned into Provence, and fixed himſelf firſt at Marſeilles; but his friends having provided an advantageous match for him at Salon, he tranſported himſelf thither in 1544. In 1546, Aix being afflicted with the plague, he went thither at the ſolicitation of the inhabitants, and was of great ſervice; particularly by a powder of his own invention: ſo that the town in gratitude gave him a conſiderable penſion for ſeveral years after the contagion ceaſed. Returning afterwards to Salon, he became a recluſe, and made uſe of his leiſure to apply himſelf to his ſtudies. He had a long time followed the trade of a conjurer occaſionally; and now he began to think himſelf inſpired, and miraculouſly illuminated with a proſpect into futurity. As faſt as theſe illuminations had diſcovered to him any future event, he entered it in writing, in ſimple proſe, but by enigmatical ſentences, as he declared himſelf; but reviſing them afterwards, he thought the ſentences would appear more reſpectable, and would ſavour more of a prophetic ſpirit, if they were expreſſed in verſe. This opinion determined him to throw them all into quatrains, and he afterwards ranged them into centuries. When this was done, he heſitated about making them public, till reflecting that the time of many events which he had foretold was very near at hand, he determined to print them. This he did with a dedication addreſſed to his ſon Cæſar, an infant only ſome months old, in the form of a letter or preface, dated March 1. 1555. This firſt edition, which is included in ſeven centuries, was printed by Rigault at Lyons. He prefixed his name in Latin, but gave to his ſon Cæſar the name as it is pronounced, *Notradame*.

Noſtradamus.

The public were divided in their ſentiments of this work: many looked upon the author as a ſimple viſionary or a fool; while he was accuſed of the black art, or black magic, by others, and treated as an impious perſon, who held a commerce with the devil: at the ſame time there were not wanting ſuch, and thoſe in great numbers, who believed him to be really and truly endued with the ſupernatural gift of prophecy. Laſtly, Some were found who remained in ſuſpenſe, and refrained from giving any judgment at all upon the point. However, Henry II. and Queen Catharine of Medicis his mother, were reſolved to ſee our prophet; and, receiving orders to that effect, he preſently repaired to Paris. He was very graciouſly received at court; and, beſides the extraordinary reſpect that was paid to him, received a preſent of 200 crowns. He was ſent afterwards to Blois, to make a viſit to his majeſty's children there, and report what he ſhould be able to diſcover concerning their deſtinies. No doubt he exerted himſelf to the utmoſt on the occaſion; but what his ſentence was is not known; however, it is certain, he returned to Salon loaded with honour and preſents. Animated with his ſucceſs, he augmented his work from 300 quatrains to the number of a complete milliade, and publiſhed it with a dedication to the king in 1558. That prince dying the next year of a wound which he received, as is well known, at a tournament, the book of our prophet was immediately conſulted; and in the 35th quatrain of the firſt century this unfortunate event was found predicted in the following verſe:

Le lion jeune le vieux ſurmontera,
En champ bellique par ſingulier duel,
Dans cage d'or les yeux lui crevera,
Deux claſſes une puis mourir, mort cruelle.

So remarkable a prediction added new wings to his fame; and he was honoured ſhortly after with a viſit from Emanuel duke of Savoy and the princeſs Margaret of France his conſort. From this time Noſtradamus found himſelf even overburdened with viſitors, and his fame made every day new acquiſitions. Charles IX. coming to Salon, was eager above all things to have a ſight of him. Noſtradamus, who then was in waiting as one of the retinue of the magiſtrates, being inſtantly preſented to his majeſty, complained of the little eſteem his countrymen had for him; whereupon the monarch publicly declared, that he ſhould hold the enemies of Noſtradamus to be his enemies, and deſired to ſee his children. Nor did that prince's favour ſtop here; in paſſing, not long after, through the city of Arles, he ſent for Noſtradamus, preſented him with a purſe of 200 crowns, Noſtre, Notæ

crowns, together with a brevet, conſtituting him his phyſician in ordinary, with the ſame appointment as the reſt. But our prophet enjoyed theſe honours only for the ſpace of ſixteen months, for he died July 2. 1566, at Salon. Beſides his "Centuries," we have the following compoſitions of his: A Treatiſe *de Fardemens et de Senteurs*, 1552.—A Book of ſingular Receipts, *pour Entretenir la Santé du Corps*, 1556.—A piece *des Confitures*, 1557. —A French Tranſlation of the Latin of Galen's Paraphraſe, exhorting Menedolas to Study, eſpecially to that of Phyſic, 1552. Some years before his death, he publiſhed a ſmall inſtruction for huſbandmen, ſhowing the beſt ſeaſons for their ſeveral labours, which he entitled, The Almanack of Noſtradamus. Laſtly, After his death there came out The eleventh and twelfth Centuries of his Quatrains, added to the former ten, which had been printed three times in two ſeparate parts. It is only in theſe firſt editions that our author's Centuries are found without alterations, additions, &c. It is to this work that the following diſtich of Stephen Jodelle alludes.

Noſtra damus cum falſa damus, nam fallere noſtrum eſt.
Et cum falſa damus, nil niſi Noſtra damus.

NOSTRE, Andrew le, comptroller of the buildings of the French king, and deſigner of his gardens, diſtinguiſhed himſelf by carrying the art of laying out gardens to great perfection. He was born at Paris in 1631; and was near 40 years of age when M. Fouquet, ſuperintendant of the finances, gave him an opportunity of becoming known by the fine gardens of Vaux-le-Vicomte. He was afterwards employed by Louis XIV. at Verſailles, Triannon, St Germains, &c. and diſcovered an admirable taſte in all his works. In 1678 he went to Rome, with the permiſſion of the French king, to improve his ſkill; but he found nothing there comparable to what he himſelf had done. Pope Innocent XI. reſolved to ſee Le Noſtre, and gave him a pretty long audience; at the concluſion of which Le Noſtre ſaid, "I have ſeen the two greateſt men in the world, your holineſs, and the king my maſter." "There is a great difference," anſwered the pope: "The king is a great victorious prince; and I am a poor prieſt, the ſervant of the ſervants of God." Le Noſtre, charmed with this anſwer, and forgetting who he was with, clapped the pope on the ſhoulder, ſaying, "Reverend father, you look extremely well, and will live to bury all the ſacred college." The pope laughed at his prediction. Le Noſtre, charmed more and more at the goodneſs of the ſovereign pontiff and the ſingular eſteem he ſhowed for the king, threw his arms about the pope's neck and kiſſed him. It was his cuſtom to behave in the ſame manner to all who ſpoke in praiſe of Louis XIV. and he even embraced the king himſelf whenever that prince returned from the country. Le Noſtre had alſo a talent for painting. He preſerved his good ſenſe and vivacity of mind to the end of his life; and died at Paris, in 1700, aged 87.

NOTÆ, ſigns uſed in writing, which have the force of many letters. This contrivance for expedition is of great antiquity. It was known to the Greeks, and from them derived to the Romans. By whom the invention was brought into Rome is not preciſely aſcertained; but the moſt general opinion † is, that in matters of importance Tully firſt made uſe of notes or ſhort-hand writing, when Cato made an oration in order to oppoſe Julius Cæſar relative to the conſpiracy of Catiline. Cicero, who was at that time conſul, placed *notarii*, or expert ſhort-hand writers, in different parts of the ſenate houſe, to take down the ſpeech; and this was the firſt public occaſion which we find recorded of employing ſhort-hand writers among the Romans. It is unneceſſary to obſerve, that hence proceeded the name of *notary* ſtill in uſe.

† *Aſtle's Origin and Progreſs of Writing.*

Notæ, Notarii.

There were three kinds of notes for ſhort-hand writing uſed by the ancients, either for diſpatch or ſecrecy. The firſt and moſt ancient was that of hieroglyphics, which are rather images or repreſentations of things than of words. (See Hieroglyphics.) The Chineſe characters are of this kind, and may with greater propriety be called *notæ* than *literæ*, as appears from what hath been already advanced.

The ſecond ſpecies of notes were called *ſingulariæ*, from their expreſſing words by ſingle letters. Sertorius Urſatus has compiled a very copious collection of ſuch abbreviations, of which work there are ſeveral editions.

The third kind of notes were called *notæ Tironianæ*, from Tiro the freed man of Cicero, who was excellently ſkilled in this art; and it is to him that we are indebted for the preſervation of Cicero's letters, of which a great part ſtill remain, and one entire book of them written to Tiro himſelf.

From books its appears, that notes were very frequent among the Romans, and continued in uſe to the 10th and 11th centuries. We have indeed but few books remaining that are written in ſhort hand; but this is not ſurpriſing, when ſuch was the unhappy ſituation of early ages, that either ſuperſtition condemned them to the flames as the works of impious magicians or necromancers, or they were left to be devoured by vermine, through ignorance and ſtupidity, which was ſo very great, that ſome people, as Trithemius affirms, looked upon notes in thoſe days as the elements of the Armenian language. It is probable, however, that there are writings of this ſort ſtill extant, which might contribute to enrich the republic of letters.

There are ſeveral MSS. and inſtruments written in theſe kind of notæ, in the royal library at Paris. In the year 1747, the learned and ingenious Monſ. Charpentier, engraved and publiſhed at Paris a capitulary, and 54 charters of Louis the Pious, emperor and king of France, written in theſe notæ Tironianæ. To this work the learned editor hath prefixed an Alphabetum Tironianum, together with a great number and variety of notes or marks for the different parts of ſpeech, and rules for acquiring the art of writing in theſe kind of notes. Valerius Probus, in his book *De Literis Antiquis*, explains many of the characters uſed by the ſhort-hand writers; and there is a dictionary of them ſet forth by Janus Gruterus. See Stenography.

NOTARII, perſons employed by the Romans to take, by *notæ*, trials and pleadings in their courts of judicature, or to write as amanuenſes from the mouth of an author. Theſe notarii were of ſervile condition. Under the reign of Juſtinian, they were formed into a college or corporate body. Notarii were alſo appointed to attend the prefects, to tranſcribe for them. There were likewiſe *notarii domeſtici*, who were employed in

keeping

keeping the accounts of the Roman nobility; and when the empire became Christian, there were notaries for ecclesiastical affairs, who attested the acts of archbishops, bishops, and other spiritual dignitaries. We find ecclesiastical notaries at Rome, under Pope Julius IV. and in the church of Antioch, about the year 370. From these notaries is derived the office of chancellor to the bishops; afterwards almost every advocate was admitted a notary.

NOTARY (NOTARIUS), signifies a person, usually some scrivener, who takes notes, or frames short draughts, of contracts, obligations, charter parties, or other writings. At present we call him a *notary public*, who publicly attests deeds or writings, in order to make them authentic in another nation: but he is principally employed in business concerning merchants; as making protests of bills of exchange, &c. And noting a bill, is where he goes to take notice of a merchant's refusal to accept or pay the same.

NOTATION, in *Arithmetic* and *Algebra*, the method of expressing numbers or quantities by signs or characters appropriated for that purpose. See ARITHMETIC and ALGEBRA.

NOTES, in *Music*, characters which mark the sounds, i. e. the elevations and fallings of the voice, and the swiftness and slowness of its motions.

NOTE is likewise used for a mark made in a book or writing, where there occurs something remarkable and worthy of particular notice: as also for an observation or explication of some passage in an author added in the margin, at the bottom of the page, or elsewhere; in which sense it stands contradistinguished to *text*.

NOTE, is also a minute, or short writing, containing some article of business; in which sense we say, promissory note, note of hand, bank note, &c.

NOTHUS, signifies *spurious*, or *bastard*; whence it is figuratively applied by physicians to such diseases as, though in respect of a similitude of symptoms, &c. they have the same denomination as some others, yet are of a different origin, seat, or the like, from the same.

NOTHUS, a Persian prince, and grandfather to Darius Codomannus. He is worthy of being mentioned only as he was progenitor to that sovereign whose overthrow conferred upon Alexander the title of *Great*.

NOTION, a word which in common language is considered as of the same import with idea. This, however, is improper. Notion comprehends the meaning of idea, but it denotes much more. We have a notion of spirit, of power, of solidity; but of these things we can have no ideas. Ideas are relicks of sensation; but there are objects of knowledge which fall under the cognizance of no sense; of these objects, however, we may have very distinct notions either direct or relative. See METAPHYSICS, N° 11.

NOTITIA, in literary history, a book that gives an account of a particular country, city, or other place: such is the *Notitia Imperii Romani*, *Notitia Romæ Antiquæ*, &c.

NOTO, an ancient, large, and handsome town of Sicily, and capital of the Val-di-Noto. It was entirely ruined by an earthquake in 1693; but the inhabitants built another town at some distance from it, which they call *Noto Nuovo*. E. Long. 14. 0. N. Lat. 36. 50.

NOTO, Val di, one of the three valleys or provinces into which Sicily is divided; and it lies between the sea, Val-di-Demona, and Val-di-Mazara. Noto is the capital town.

NOTONECTA, the boat fly, a genus of insects belonging to the order of hemiptera. See ENTOMOLOGY *Index*.

NOTTEBURG, a town of Russia, in the province of Ingria, seated on an island in the lake Ladoga, at the place where the river Neva proceeds from this lake. It is strong, has a good citadel, and was capital of the province before Petersburg was built. E. Long. 31. 40. N. Lat. 60. 0.

NOTTINGHAMSHIRE, a county of England, bounded on the east by Lincolnshire, on the south-east and south by Leicestershire, on the west by Derbyshire, and on the north and north-west by Yorkshire. It extends in length 48 miles, 25 in breadth, and 110 in compass; containing 560,000 acres, 8 hundreds, 9 market towns, 168 parishes, 450 villages, about 25,611 houses, and 140,350 inhabitants. No county in England enjoys a pleasanter and healthier air. As for the soil, it differs widely in different parts of the county. Towards the west, where lies the forest of Sherwood, it is sandy; and therefore that part of the county is called by the inhabitants the *Sand;* but the south and east parts, watered by the Trent and the rivulets that fall into it, are clayey; and for that reason are called by the inhabitants the *Clay*. The latter is fruitful both in corn and pasture; but the former produces little besides wood, coal, and some lead. The county has a variety of commodities and manufactures, as wool, leather, tallow, butter, cheese, coal, marl, cattle, malt, liquorice, stockings, glass, earthen wares, and strong ale. The principal rivers are the Trent and Idle. The Trent, whose name is supposed to be derived from the French or Latin word signifying *thirty*, either because it receives thirty smaller rivers, or has thirty different sorts of fish in it, is inferior to no river in England, but the Severn, Thames, and Humber. It enters the county on the south-west, and passes through it to the north-east, where it enters Lincolnshire, and after a long course falls at last into the Humber. The Idle rises in Sherwood forest, and after traversing the northern part of the county, falls into the Trent upon the borders of Yorkshire and Lincolnshire.

The spacious forest of Sherwood lies in the west part of the county, and indeed takes up the greatest part of it. It was formerly so thick, that it was hardly passable; but now it is much thinner. It feeds an infinite number of deer and stags; and has some towns in it, of which Mansfield is the chief. It abounds in coal, and a road lies through it for thirty miles together. Since the reign of King Edward I. the nobility and gentry have had grants of it. It was governed by a great number of officers under the late earl of Chesterfield, chief forester; whose ancestor, Sir John Stanhope, had a grant of it, with liberty to destroy and kill at pleasure, reserving only a hundred deer in the whole walk. The duke of Newcastle is now steward and keeper. The principal town is

NOTTINGHAM, which gives name to the county. It is a handsome town, and a county of itself by charter. The name is derived from the Saxon word *Snottengham*, which signifies *caves*, from the caves and apartments anciently dug in the rocks on which the town stands. These, being soft, easily yield to the spade and pickaxe; whence

Nottingham. whence the townſmen have excellent cellars for the vaſt quantities of malt liquors made here, and ſent, as well as their malt, to moſt parts of England. The ſituation of the town is very pleaſant, having meadows on one hand, and hills of a gentle eaſy aſcent, on the other. It is well ſupplied with fuel, both wood and coal, from the foreſt; and with fiſh by the Trent, which runs about a mile to the ſouth of it, and has been made navigable for barges: ſo that they receive by it not only great quantities of cheeſe from Warwickſhire and Staffordſhire; but all their heavy goods from the Humber, and even from Hull. Over the Trent is a ſtately ſtone bridge of 19 arches, where the river is very large and deep, having received the addition of the Dove, the Derwent, the Irwaſh, and the Soar, three of them great rivers of themſelves, which fall into it after its paſſing by Burton in Staffordſhire.

The town is of great antiquity, and it had formerly a ſtrong caſtle, in which the Danes, in the time of the heptarchy, held out a ſiege againſt Buthred king of Mercia, Alfred, and Ethelred his brother, king of the Weſt Saxons.

Soon after the Conqueſt, William either repaired this fortreſs, or built a new one on the ſame ſpot, in the ſecond year of his reign, probably to ſecure a retreat on his expedition againſt Edwin earl of Cheſter and Morcar earl of Northumberland, who had revolted. He committed the cuſtody of it to William Peverell, his natural ſon, who has by ſome been conſidered as the founder. It ſtands on a ſteep rock, at the foot of which runs the river Leen.

Deering, in his hiſtory of Nottingham, ſeems very juſtly to explode the ſtory of the place called Mortimer's Hole, having been made as a hiding place for him; and from his deſcription of it, ſhows that it was meant as a private paſſage to the caſtle, to relieve it with men or proviſions in a ſiege. He ſays that it is one continued ſtaircaſe, without any room, or even a place to ſit down on. It was by this paſſage that Edward III. got into the caſtle and ſurpriſed Mortimer and the queen; and from hence, and his being carried away through it, it has its name.

Edward IV. greatly enlarged the caſtle, but did not live to complete the buildings he began. Richard III. finiſhed them.

It was granted by James I. to Francis earl of Rutland, who pulled down many of the buildings; but it was ſtill of ſo much ſtrength, that Charles I. in 1642, pitched on it as the place for beginning his operations of war. He ſet up his ſtandard, firſt on the walls of the caſtle, but in two or three days removed it to a cloſe on the north ſide of the caſtle, without the wall, on a round ſpot; after which it was for many years called Standard cloſe, and ſince, from the name of one who rented it, Nevil's cloſe. Where the ſtandard was fixed, there ſtood a poſt for a conſiderable time. It is a common error that it was erected on a place called Derrymount, a little further north than the cloſe juſt mentioned; this is an artificial hill, raiſed on purpoſe for a wind-mill, which formerly was there. The caſtle was afterwards ſequeſtered by the parliament, and the trees in the park cut down.

This caſtle was ſo ſtrong that it was never taken by ſtorm. After the civil war, Cromwell ordered it to be demoliſhed. On the Reſtoration, the duke of Buckingham, whoſe mother was daughter and heir of this Francis earl of Rutland, had it reſtored to him, and ſold it to William Cavendiſh, marquis and afterwards duke of Newcaſtle. In 1674 he began the preſent building, but died in 1676, when the work was not far advanced. However, he had the building of it ſo much at heart, that he left the revenue of a conſiderable eſtate to be applied to that purpoſe, and it was finiſhed by Henry his ſon. The expence was about 14,000l. It is one of the ſeats of the preſent duke of Newcaſtle.

In the park, weſt of the caſtle, and facing the river Leen, are ſome remains of an ancient building (if it may be ſo called) cut and framed in the rock. Dr Stukeley gives it, as he does moſt things, to the Britons. Many other ancient excavations have been found in other parts of the rocks.

The frames for knitting ſtockings were invented by one William Lea of this county, about the beginning of the 17th century; but not meeting with the encouragement he expected (a caſe too common with the firſt inventors of the moſt uſeful arts) he went with ſeveral of his workmen to France, on the invitation of Henry IV. The death of that king, and the troubles which enſued, prevented attention being given to the work. Lea died there, and moſt of his men returned to England. Other attempts were made to ſteal the trade, without better ſucceſs, and it has flouriſhed here ever ſince, and is now carried on to a very conſiderable extent. It is noted for its horſe-races on a fine courſe on the north ſide of the town. The corporation is governed by a mayor, recorder, ſix aldermen, two coroners, two ſheriffs, two chamberlains, and twenty-four common-council men, eighteen of the ſenior council, and ſix of the junior, a bell-bearer, and two pinders, one for the fields and the other for the meadows. The town being within the juriſdiction of the foreſt, the former of theſe pinders is town-woodward, and attends the foreſt courts. It has three neat churches, the chief of which is St Mary's; and an alms-houſe, endowed with 100l. a-year, for twelve poor people; with a noble townhouſe, ſurrounded with piazzas. A conſiderable trade is carried on in glaſs and earthen wares, and frame ſtockings, beſides the malt, and malt liquors, mentioned above. Marſhal Tallard, when a priſoner in England, was confined to this town and county. In the duke of Newcaſtle's park there is a ledge of rocks hewn into a church, houſes, chambers, dove-houſes, &c. The altar of the church is natural rock; and between that and the caſtle there is a hermitage of the like workmanſhip. Upon the ſide of a hill there is a very extraordinary ſort of a houſe, where you enter at the garret, and aſcend to the cellar, which is at the top of the houſe. Here is a noted hoſpital founded by John Plumtree Eſq. in the reign of Richard II. for thirteen poor old widows. There are four handſome bridges over the Trent and Lind. To keep theſe in repair, and for other public purpoſes, the corporation has good eſtates. This town and Winchelſea both give title of earl to the noble family of Finch. Here David king of Scots, when a priſoner in England, reſided; and under ground is a vault, called *Mortimer's hole* becauſe Roger Mortimer. earl of March is ſaid to have concealed himſelf in it, when he was taken and hanged by order of Edward III. W. Long. 1. 5. N. Lat. 53. 0.

NOVA SCOTIA. See *Nova SCOTIA.*

NOVA *Zembla*. See *Nova ZEMBLA.*

NOVALLE, a ſmall, rich, and populous town of Italy, between Padua and Treviſo. E. Long. 12. 5. N. Lat. 45. 35.

NOVARA, an ancient and ſtrong city of Italy, in the duchy of Milan, and capital of the Novareſe. Some pretend that this city was built by the Trojans, and ſo called *quaſi Nova Ara*, becauſe they had erected there a temple to Venus. Tacitus mentions its being made a municipal city by the Romans, and there are many inſcriptions ſtill extant, which ſufficiently prove its ancient ſplendour. It is now a ſmall but well-built town, ſituated on a little eminence, in a fine country, betwixt two rivers, very well fortified, and is the ſee of a biſhop ſuffragan of Milan. It is remarkable for the ſeveral ſieges ſuſtained in paſt times, and for being the birth-place of Peter Lombard, maſter of the ſentences. E. Long. 8. 35. N. Lat. 45. 25.

NOVATIAN, who made ſo much noiſe and ſo greatly diſturbed the peace of the church, was, we are told, firſt a Pagan philoſopher. He was baptized in bed when dangerouſly ill: recovering, however, he was afterwards ordained prieſt of the church of Rome, his biſhop having obtained this favour for him, which the clergy and people were far from being diſpoſed to grant. He does not appear to have had the good of the church much at heart; for with his wit, knowledge, and eloquence, he might have been peculiarly ſerviceable to her, had he not with cowardice ſhrunk from his duty when he dreaded perſecution. His ambition to be made a biſhop likewiſe miſled him; and what occaſioned the apoſtaſy of moſt of the firſt hereſiarchs, alſo occaſioned his. On the death of Fabian biſhop of Rome, after writing a letter to St Cyprian, he remained quiet whilſt the ſee was vacant; but the promotion of Cornelius to that dignity excited his envy and jealouſy to no common pitch. The conſequence was a ſeparation from the new biſhop, and from thoſe who profeſſed to believe, what Novatian ſtrenuouſly denied, that the church could receive thoſe again who had been guilty of idolatry. He ſoon got a number of followers among the laity, and ſome even among the clergy. Novatus, a prieſt of Carthage, was one of his party, and having been a party-man himſelf againſt St Cyprian, brought his adherents with him. He got himſelf conſecrated biſhop of Rome in a moſt infamous and clandeſtine manner, by three weak men whom he had moſt groſsly impoſed upon, and one of whom did penance for having been concerned in what was ſo contrary to order, decency, and the rules of the church.

His deſigns, however, in this diſgraceful affair did not ſucceed, for he was not acknowledged as biſhop of that dioceſe; Cornelius being confirmed in it, whilſt he was condemned and excommunicated. He ſtill however, taught his doctrine, and at length became the head of the party which bears his name. Beſides the letter mentioned above, St Jerome ſays he wrote on the *Paſſover*, on the *Sabbath*, on *Circumciſion*, on the *High Prieſts*, on *Prayer*, on *Jewiſh meals*, and on *Firmneſs of mind*, &c. with a large treatiſe *on the Trinity*. None of them appear under his own name, and ſome are thought not to be his.

NOVATIANS, *Novatiani*, a ſect of ancient heretics, that aroſe towards the cloſe of the third century, ſo called from Novatian, a prieſt of Rome, (ſee the preceding article.) They were called alſo *Cathari*, from *καθαρος pure*, q. d. Puritans.

Novatian firſt ſeparated from the communion of Pope Cornelius, on pretence of his being too eaſy in admitting to repentance thoſe who had fallen off in times of perſecution.

Novatus coming to Rome, joined himſelf to the faction of Novatian; and both maintained, that there was no other admiſſion into the church but by the repentance in baptiſm; grounding their opinion on that of St Paul: "It is impoſſible for thoſe once "enlightened, and who have taſted the heavenly gift, "if they fall away, to renew themſelves by repent-"ance."

Not that they denied but a perſon fallen into any ſin, how grievous ſoever, might obtain pardon by repentance; for they themſelves recommend repentance in the ſtrongeſt terms: but their doctrine was, that the church had it not in its power to receive ſinners into its communion, as having no way of remitting ſins but by baptiſm; which once received could not be repeated.

In proceſs of time the *Novatians* ſoftened and moderated the rigour of their maſter's doctrine, and only refuſed abſolution to very great ſinners.

The two leaders were proſcribed, and declared heretics, not for excluding penitents from communion, but for denying that the church had a power of remitting ſins. See NOVATUS.

NOVATION, or INNOVATION, in the *Civil Law*, denotes the change of one kind of obligation for another; as when a promiſe is accepted inſtead of a written obligation.

NOVATUS, a prieſt of Carthage, in the third century, who, to avoid being puniſhed for a crime, joined with the deacon, named *Feliciſſimus*, againſt St Cyprian. He went to Rome in 251; and there found Novatian, who had acquired great reputation by his eloquence, but who murmured at his not being raiſed to the ſee of Rome in preference to Cornelius. Novatus contracted a friendſhip with him; and afterwards promoted the deteſtable conſecration of Novatian to the ſee of Rome. This irregular conſecration produced a very great ſchiſm. Novatus alſo maintained, that the church had not the power to receive thoſe to communion who were fallen into idolatry.

NOVEL, a fictitious narrative in proſe, which profeſſes to exhibit the natural workings of the human heart, the happineſs and miſery of private life, and, above all, the nature of the affection called *Love*, and the conſequence of indulging it in certain circumſtances.

The novel ſprung out of the old romance, and has been cenſured for inſipidity, as its parent was for extravagance. (See ROMANCE.) That the greater part of thoſe abſurd things, which, under this title, are daily iſſuing from the preſs, deſerve all the contempt with which they can be treated, is a poſition which we feel not ourſelves inclined to controvert; but we cannot admit that any ſpecies of writing is in itſelf inſipid, merely becauſe numbers have attempted it without ſucceſs. The heroic poems of Blackmore are univerſally

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versally known to be contemptible performances; and if we had before us all the heroic poetry that has ever been written, how many thousands of volumes should we have as mean as either *Prince Arthur*, *King Arthur*, *Elize*, or *Alfred?* Yet no critic has hitherto dared to maintain, that heroic poetry is an insipid species of writing.

But to the novel objections have been urged of more importance than its insipidity. It has been often affirmed, with learned solemnity, that the perusal of novels tends to corrupt the youth of both sexes; to produce effeminacy in men and extravagant notions of the happiness of love in women; that it diverts the minds of the former from more serious and useful studies, and exposes the latter to the arts of seduction. That there are too many novels to which this objection is applicable in its full force, is a fact which we are afraid cannot be denied: but when it is admitted, let not these performances be again accused of insipidity: for were they insipid, they could have no such consequences. It is by laying fast hold of the heart that they lead it astray. That a novel might be written so as to interest the heart in behalf of virtue, as much as any one has ever warped it to the side of vice, is a truth which no man will ever venture to call in question who has any knowledge of human nature; and therefore we are decidedly of opinion, that there may be novels worthy at once of the perusal of inexperienced youth and hoary wisdom. A critic *, by no means too indulgent to works of fancy, and among whose failings laxity of morals has never been numbered, thus expresses himself on the subject of novel-writing:—

* *Johnson.*

"These familiar histories may perhaps be made of greater use than the solemnities of professed morality, and convey the knowledge of vice and virtue with more efficacy than axioms and definitions. But if the power of example is so great, as to take possession of the memory by a kind of violence, and produce effects almost without the intervention of the will, care ought to be taken, that, when the choice is unrestrained, the best examples only should be exhibited; and that what is likely to operate so strongly, should not be mischievous or uncertain in its effects."

We have said, that the novel professes above all things to exhibit the nature of love and its consequences. Whether this be essential to such performances may perhaps be reasonably questioned: but it has been made an important part of the drama in most novels, and, we think, with great propriety. It is the object of the novelist to give a true picture of life, diversified only by accidents that daily happen in the world, and influenced by passions and qualities which are really to be found in conversing with mankind. To accomplish this object, he conceives a hero or heroine, whom he places in a certain rank of life, endues with certain qualities of body and mind, and conducts, through many vicissitudes of fortune, either to the summit of happiness or to the abyss of misery, according to the passion which he wishes to excite in his readers. In the modern novel, this hero or heroine is never placed on a throne, or buried in a cottage; because to the monarch and the cottager no difficulties occur which can deeply interest the majority of readers. But among the virtuous part of the intermediate orders of society, that affection which we call *love* seldom fails, at some period of life, to take possession of the hearts of both sexes; and wherever it has place, it must be productive of happiness or of misery. In the proper management of this passion consists much of the difficulty of the novel-writer. He must exhibit his hero as feeling all the pangs and pleasures of love, as sometimes animated with hope, and sometimes ready to sink into despair, but always exerting himself to obtain the gratification of his wishes. In doing this, care should be taken, either that he never transgress the laws of virtue, or at least that he never transgress them with impunity.

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"It is justly considered as the greatest excellency of art to imitate nature; but it is necessary to distinguish those parts of nature which are most proper for imitation: greater care is still required in representing life, which is so often discoloured by passion or deformed by wickedness. If the world be promiscuously described, I cannot perceive (says the great critic already quoted) of what use it can be to read the account; or why it may not be as safe to turn the eye immediately upon mankind, as upon a mirror which shows all that presents itself without discrimination. It is therefore not a sufficient vindication of a character, that it is drawn as it appears; for many characters ought never to be drawn: nor of a narrative, that the train of events is agreeable to observation; for that observation which is called knowledge of the world will be found much more frequently to make men cunning than good. The purpose of these writings is surely not only to show mankind, but to provide that they may be seen hereafter with less hazard; to teach the means of avoiding the snares which are laid by TREACHERY for INNOCENCE, without ensuring any wish for that superiority with which the betrayer flatters his vanity; to give the power of counteracting fraud, without the temptation to practice it; to initiate youth by mock encounters in the art of necessary defence; and to increase prudence without impairing virtue.

"Many writers, for the sake of following nature, so mingle good and bad qualities in their principal personages, that they are both equally conspicuous; and as we accompany them through their adventures with delight, and are led by degrees to interest ourselves in their favour, we lose the abhorrence of their faults, because they do not hinder our pleasures, or perhaps regard them with some kindness for being united with so much merit.—There have been men indeed splendidly wicked, whose endowments threw a brightness on their crimes, and whom scarce any villany made perfectly detestable, because they never could be wholly divested of their excellencies: but such have been in all ages the great corrupters of the world; and their resemblance ought no more to be preserved than the art of murdering without pain.

"In narratives, where historical veracity has no place, there should be exhibited the most perfect idea of virtue; of virtue not angelical, nor above probability (for what we cannot credit we shall never imitate), but the highest and purest that humanity can reach, which, exercised in such trials as the various revolutions of things shall bring upon it, may, by conquering some calamities and enduring others, teach us what we may hope, and what we can perform. Vice (for vice is ne-

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ceſſary to be ſhown) ſhould always diſguſt; nor ſhould the graces of gaiety, or the dignity of courage, be ſo united with it, as to reconcile it to the mind. Wherever it appears, it ſhould raiſe hatred by the malignity of its practices, and contempt by the meanneſs of its ſtratagems; for while it is ſupported by either parts or ſpirit, it will ſeldom be heartily abhorred."

If theſe obſervations be juſt, and to us they appear unanſwerable, Richardſon's *Lovelace* is a character which ought never to have been drawn. In the graces of gaiety and the dignity of courage, in liberality without profuſion, in perſeverance and addreſs, he everywhere appears as the firſt of men; and that honour with which he protects the virtue of his *Roſebud*, if any inſtruction is to be drawn from it, can only lead the admirers of Richardſon to believe that another Clariſſa might be in perfect ſafety were ſhe to throw herſelf upon the honour of another Lovelace. Yet in the compoſition of this ſplendid character there is not one principle upon which confidence can ſecurely reſt; and Lovelace, whilſt he is admired by the youth of both ſexes, and eſcapes the contempt of all mankind, muſt excite in the breaſt of the cool moraliſt ſentiments of abhorrence and deteſtation. A French critic †, ſpeaking of this character, ſays, "By turns I could embrace and fight with Lovelace. His pride, his gaiety, his drollery, charm and amuſe me: his genius confounds me and makes me ſmile; his wickedneſs aſtoniſhes and enrages me; but at the ſame time I admire as much as I deteſt him." Surely this is not the character which ought to be preſented to the inexperienced and ardent mind.

† The author of *La jolie femme*, or *La femme du jour.*

The moſt perfect characters which we at preſent recollect in any novel are Richardſon's Grandiſon and Fielding's Allworthy. The virtues of the former are perhaps tinctured with moral pedantry, if we may uſe the expreſſion: and the latter ſuffered himſelf to be long impoſed upon by the arts of the hypocrite and the philoſophical coxcomb; but without ſome defects they would not be human virtues, and therefore no objects of human imitation. Clariſſa is an excellent character: ſhe has as much perfection as can be expected in woman, whilſt ſhe exhibits, at the ſame time, ſome obvious defects.

As it is the object of the noveliſt to intereſt the heart, and to communicate inſtruction through the medium of pleaſure, his work, like a tragedy or comedy, ſhould be one, exhibiting a hero or heroine, whoſe ſucceſs every incident ſhould contribute to forward or to retard. In this reſpect no work of fancy has ever ſurpaſſed the Tom Jones of Fielding. It is conſtructed upon principles of the soundeſt criticiſm, and contains not a ſingle event which does not in ſome way contribute towards the winding up of the piece. A living author, deeply read in Grecian literature, and far from being prejudiced in behalf of any modern, has been heard to ſay, that had Ariſtotle ſeen Tom Jones, he would have pronounced it a poem perfect in its kind.

Againſt this ſentence another critic of name has entered his proteſt, and ſtrenuouſly maintained that nothing can be a poem which is not written in verſe. We ſhall judge of the truth of this concluſion by comparing it with the principles from which it is deduced. Having laid down as a maxim incontrovertible, that "the end of poetry is pleaſure, to which uſe itſelf muſt be ſubſervient," he very juſtly infers from this IDEA, that "poetry ſhould neglect no advantage that fairly offers itſelf, of appearing in ſuch a dreſs or mode of language as is moſt taking and agreeable to us. It follows (he ſays), from the ſame idea of the *end* which poetry would accompliſh, that not only rhythm, but NUMBERS properly ſo called, is eſſential to it, and that it cannot obtain its own purpoſe unleſs it be clothed in VERSE." He then proceeds to aſk, "What, from this concluſion, are we to think of thoſe *novels* or *romances*, as they are called, which have been ſo current of late through all Europe? As they propoſe pleaſure for their end, and proſecute it, beſides, in the way of *fiction*, though without metrical numbers, and generally indeed in harſh and rugged proſe, one eaſily ſees what their pretenſions are, and under what idea they are ambitious to be received. Yet as they are wholly deſtitute of meaſured ſounds (to ſay nothing of their other numberleſs defects), they can at moſt be conſidered but as haſty, imperfect, and abortive poems: whether ſpawned from the dramatic or narrative ſpecies, it may be hard to ſay.

Unfiniſh'd things one knows not what to call,
Their generation's ſo equivocal.

However, ſuch as they are, thoſe *novelties* have been generally well received: *Some* for the real merit of their execution; *others*, for their amuſing ſubjects; all of them for the gratification they afford, or at leaſt promiſe, to a vitiated, pallid, and ſickly imagination, that laſt diſeaſe of learned minds, and ſure prognoſtic of expiring letters. But whatever may be the temporary ſucceſs of theſe things (for they vaniſh as faſt as they are produced), good ſenſe will acknowledge no work of art but ſuch as is compoſed according to the law of its kind."

Of this ſevere criticiſm the author himſelf has given us, what amounts to a complete confutation. He tells us, that the ancients looked for ſo much force and ſpirit of expreſſion in whatever they dignified with the name of *poem*, as ſometimes to make a queſtion "whether comedy were rightly referred to this claſs, becauſe it differed only in meaſure from mere proſe? Their doubt (he juſtly adds) might have been ſpared or at leaſt reſolved, if they had conſidered that comedy adopts as much of this force and ſpirit of words as is conſiſtent with the nature and dignity of that pleaſure which it pretends to give: For the name of *poem* will belong to every compoſition whoſe *primary* end is to pleaſe, provided it be ſo conſtructed as to afford *all* the pleaſure which its kind or ſort will permit."

If this deciſion be juſt, and we readily admit it, a well compoſed novel is entitled to the appellation of a *poem*, though it be written in proſe and in a ſtyle not remarkable for elevation. The buſineſs of the noveliſt is to intereſt the heart by a diſplay of the incidents of common life. In doing this, he muſt exhibit ſcenes that are probable, and record ſpeeches that are natural. He is not at liberty to invent, but only to ſelect, objects, and to cull from the maſs of mankind thoſe individuals upon which the attention ought moſt to be employed. The more cloſely he adheres to this rule, the more deeply does he intereſt us in his narrative; becauſe every reader ſees at once that it is poſſible he may at ſome time or other be in circumſtances nearly reſembling thoſe of the hero of the tale. But the buſineſs of life

Novel, Novelty. life is not tranfacted in pompous language, nor the fpeeches of real lovers made in verfe either rhymed or blank. Were *Tom Jones* or *Clariffa Harlowe* to be tranflated into verfe, we fhall venture to affert that they would quickly lofe their hold of the public mind: becaufe the hero and heroine would then appear in a light which every heart muft feel to be unnatural.

It is well obferved by Johnfon, that the tafk of the novel writer "requires, together with that learning which is to be gained from books, that experience which can never be attained by folitary diligence, but muft arife from general converfe and accurate obfervation of the living world. Their performances have, as Horace expreffes it, *plus oneris quantum variæ minus*, little indulgence, and therefore more difficulty. They are engaged in portraits of which every one knows the original, and can detect any deviation from exactnefs of refemblance. Other writings are fafe, except from the malice of learning, but thefe are in danger from every common reader; as the flipper ill executed was cenfured by a fhoemaker who happened to ftop in his way at the Venus of Apelles." It is in thus faithfully copying nature that the excellence of Fielding confifts. No man was ever better acquainted with the fhades which diverfify characters, and none ever made his perfonages act and fpeak more like real men and women in the particular circumftances which he defcribes.

"But the fear of not being approved as a juft copier of human manners, is not the moft important concern that an author of this clafs ought to have before him. Novels are written chiefly to the young, the ignorant, and the idle, to whom they ferve as lectures of conduct and introduction into life. In every fuch work, it fhould therefore be carefully inculcated, that virtue is the higheft proof of underftanding, and the only folid bafis of greatnefs; and that vice is the natural confequence of narrow thoughts; that it begins in miftake and ends in ignominy: and fince love muft be introduced, it fhould be reprefented as leading to wretchednefs, whenever it is feparated from duty or from prudence."

Novel, in the civil law, a term ufed for the conftitutions of feveral emperors, more particularly thofe of Juftinian. They were called *novels*, either from their producing a great alteration in the face of the ancient law, or becaufe they were made on new cafes, and after the revifal of the ancient code.

NOVELTY, or Newness. Of all the circumftances that raife emotions, not excepting beauty, nor even greatnefs, fays Lord Kames *, novelty hath the moft powerful influence. A new object produces inftantaneoufly an emotion termed *wonder*, which totally occupies the mind, and for a time excludes all other objects. Converfation among the vulgar never is more interefting than when it turns upon ftrange objects and extraordinary events. Men tear themfelves from their native country in fearch of things rare and new; and novelty converts into a pleafure the fatigues and even perils of travelling. To what caufe fhall we afcribe thefe fingular appearances? To curiofity undoubtedly; a principle implanted in human nature for a purpofe extremely beneficial, that of acquiring knowledge; and the emotion of wonder raifed by new and ftrange objects, inflames our curiofity to know more of fuch objects. This emotion is different from *admiration*: novelty, wherever found, whether in a quality or action, is the caufe of wonder; admiration is directed to the perfon who performs any thing wonderful.

* *Elements of Criticifm.*

Novelty. During infancy, every new object is probably the occafion of wonder, in fome degree; becaufe, during infancy, every object at firft fight is ftrange as well as new: but as objects are rendered familiar by cuftom, we ceafe by degrees to wonder at new appearances, if they have any refemblance to what we are acquainted with; for a thing muft be fingular as well as new, to raife our wonder. To fave multiplying words, we would be underftood to comprehend both circumftances when we hereafter talk of novelty.

In an ordinary train of perceptions, where one thing introduces another, not a fingle object makes its appearance unexpectedly: the mind thus prepared for the reception of its objects, admits them one after another without perturbation. But when a thing breaks in unexpectedly, and without the preparation of any connection, it raifes an emotion, known by the name of *furprife*. That emotion may be produced by the moft familiar object, as when one unexpectedly meets a friend who was reported to be dead; or a man in high life, lately a beggar. On the other hand, a new object, however ftrange, will not produce the emotion, if the fpectator be prepared for the fight: an elephant in India will not furprife a traveller who goes to fee one; and yet its novelty will raife his wonder: an Indian in Britain would be much furprifed to ftumble upon an elephant feeding at large in the open fields; but the creature itfelf, to which he was accuftomed, would not raife his wonder.

Surprife thus in feveral refpects differs from wonder: unexpectednefs is the caufe of the former emotion; novelty is the caufe of the latter. Nor differ they lefs in their nature and circumftances, as will be explained by and by. With relation to one circumftance they perfectly agree; which is, the fhortnefs of their duration: the inftantaneous production of thefe emotions in perfection, may contribute to that effect, in conformity to a general law, That things foon decay which foon come to perfection: the violence of the emotions may alfo contribute; for an ardent emotion, which is not fufceptible of increafe, cannot have a long courfe. But their fhort duration is occafioned chiefly by that of their caufes: we are foon reconciled to an object, however unexpected; and novelty foon degenerates into familiarity.

Whether thefe emotions be pleafant or painful, is not a clear point. It may appear ftrange, that our own feelings and their capital qualities fhould afford any matter for a doubt: but when we are engroffed by any emotion, there is no place for fpeculation; and when fufficiently calm for fpeculation, it is not eafy to recal the emotion with accuracy. New objects are fometimes terrible, fometimes delightful: the terror which a tyger infpires is greateft at firft, and wears off gradually by familiarity: on the other hand, even women will acknowledge that it is novelty which pleafes the moft in a new fafhion. It would be rafh, however, to conclude, that wonder is in itfelf neither pleafant nor painful, but that it affumes either quality according to circumftances. An object, it is true, that hath a threatening appearance, adds to our terror by its novelty: but from that experiment it doth not follow, that novelty is in itfelf difagreeable;

Novelty. disagreeable; for it is perfectly consistent, that we be delighted with an object in one view, and terrified with it in another. A river in flood swelling over its banks, is a grand and delightful object; and yet it may produce no small degree of fear when we attempt to cross it: courage and magnanimity are agreeable; and yet, when we view these qualities in an enemy, they serve to increase our terror. In the same manner, novelty may produce two effects clearly distinguishable from each other: it may, directly and in itself, be agreeable; and it may have an opposite effect indirectly, which is, to inspire terror; for when a new object appears in any degree dangerous, our ignorance of its powers and faculties affords ample scope for the imagination to dress it in the most frightful colours. The first sight of a lion, for example, may at the same instant produce two opposite feelings, the pleasant emotion of wonder, and the painful passion of terror: the novelty of the object produces the former directly, and contributes to the latter indirectly. Thus, when the subject is analyzed, we find that the power which novelty hath indirectly to inflame terror, is perfectly consistent with its being in every circumstance agreeable. The matter may be put in the clearest light, by adding the following circumstance. If a lion be first seen from a place of safety, the spectacle is altogether agreeable without the least mixture of terror. If, again, the first sight puts us within reach of that dangerous animal, our terror may be so great as quite to exclude any sense of novelty. But this fact proves not that wonder is painful: it proves only, that wonder may be excluded by a more powerful passion. Every man may be made certain from his own experience, that wonder raised by a new object that is inoffensive, is always pleasant; and with respect to offensive objects, it appears, from the foregoing deduction, that the same must hold as long as the spectator can attend to the novelty.

Whether surprise be in itself pleasant or painful, is a question not less intricate than the former. It is certain that surprise inflames our joy when unexpectedly we meet with an old friend; and not less our terror when we stumble upon any thing noxious. To clear that question, the first thing to be remarked is, that in some instances an unexpected object overpowers the mind, so as to produce a momentary stupefaction: where the object is dangerous, or appears so, the sudden alarm it gives, without preparation, is apt totally to unhinge the mind, and for a moment to suspend all its faculties, even thought itself; in which state a man is quite helpless: and if he move at all, is as like to run upon the danger as from it. Surprise carried to such a height, cannot be either pleasant or painful; because the mind, during such momentary stupefaction, is in a good measure, if not totally, insensible. Novelty.

If we then inquire for the character of this emotion, it must be where the unexpected object or event produceth less violent effects. And while the mind remains sensible of pleasure and pain, is it not natural to suppose, that surprise, like wonder, should have an invariable character? It would appear, however, that surprise has no invariable character, but assumes that of the object which raises it. Wonder being an emotion invariably raised by novelty, and being distinguishable from all other emotions, ought naturally to possess one constant character. The unexpected appearance of an object, seems not equally entitled to produce an emotion distinguishable from the emotion, pleasant or painful, that is produced by the object in its ordinary appearance: the effect it ought naturally to have, is only to swell that emotion, by making it more pleasant or more painful than it commonly is. And that conjecture is confirmed by experience, as well as by language which is built upon experience: when a man meets a friend unexpectedly, he is said to be agreeably surprised; and when he meets an enemy unexpectedly, he is said to be disagreeably surprised. It appears, then, that the sole effect of surprise is to swell the emotion raised by the object. And that effect can be clearly explained: a tide of connected perceptions glide gently into the mind, and produce no perturbation; but an object breaking in unexpectedly, sounds an alarm, rouses the mind out of its calm state, and directs its whole attention to the object, which, if agreeable, becomes doubly so. Several circumstances concur to produce that effect: on the one hand, the agitation of the mind and its keen attention prepare it in the most effectual manner for receiving a deep impression: on the other hand, the object, by its sudden and unforeseen appearance, makes an impression, not gradually as expected objects do, but as at one stroke with its whole force. The circumstances are precisely similar where the object is in itself disagreeable (A).

The pleasure of novelty is easily distinguished from that of variety: to produce the latter, a plurality of objects is necessary; the former arises from a circumstance found in a single object. Again, Where objects, whether co-existent or in succession, are sufficiently diversified, the pleasure of variety is complete, though every single object of the train be familiar; but the pleasure of novelty, directly opposite to familiarity, requires no diversification.

There are different degrees of novelty, and its effects are

(A) What Mareschal Saxe terms *le cœur humain*, is no other than fear occasioned by surprise. It is owing to that cause that an ambush is generally so destructive: intelligence of it beforehand renders it perfectly harmless. The Mareschal gives from Cæsar's Commentaries two examples of what he calls *le cœur humain*. At the siege of Amiens by the Gauls, Cæsar came up with his army, which did not exceed 7000 men; and began to entrench himself in such hurry, that the barbarians judging him to be afraid, attacked his entrenchments with great spirit. During the time they were filling up the ditch, he issued out with his cohorts, and by attacking them unexpectedly struck a panic that made them fly with precipitation, not a single man offered to make a stand. At the siege of Alesia, the Gauls infinitely superior in number, attacked the Roman lines of circumvallation, in order to raise the siege. Cæsar ordered a body of his men to march out silently, and to attack them on the one flank, while he with another body did the same on the other flank. The surprise of being attacked when they expected a defence only, put the Gauls into disorder, and gave an easy victory to Cæsar.

are in proportion. The loweſt degree is found in objects ſurveyed a ſecond time after a long interval; and that in this caſe an object takes on ſome appearance of novelty, is certain from experience: a large building of many parts variouſly adorned, or an extenſive field embelliſhed with trees, lakes, temples, ſtatues, and other ornaments, will appear new oftener than once: the memory of an object ſo complex is ſoon loſt, of its parts at leaſt, or of their arrangement. But experience teaches, that, even without any decay of remembrance, abſence alone will give an air of novelty to a once familiar object; which is not ſurpriſing, becauſe familiarity wears off gradually by abſence: thus a perſon with whom we have been intimate, returning after a long interval, appears like a new acquaintance. And diſtance of place contributes to this appearance, not leſs than diſtance of time: a friend, for example, after a ſhort abſence in a remote country, has the ſame air of novelty as if he had returned after a longer interval from a place nearer home: the mind forms a connexion between him and the remote country, and beſtows upon him the ſingularity of the objects he has ſeen. For the ſame reaſon, when two things equally new and ſingular are preſented, the ſpectator balances between them; but when told that one of them is the product of a diſtant quarter of the world, he no longer heſitates, but clings to it as the more ſingular: hence the preference given to foreign luxuries, and to foreign curioſities, which appear rare in proportion to their original diſtance.

The next degree of novelty, mounting upward, is found in objects of which we have ſome information at ſecond hand; for deſcription, though it contribute to familiarity, cannot altogether remove the appearance of novelty when the object itſelf is preſented: the firſt ſight of a lion occaſions ſome wonder, after a thorough acquaintance with the correcteſt pictures and ſtatues of that animal.

A new object that bears ſome diſtant reſemblance to a known ſpecies, is an inſtance of a third degree of novelty: a ſtrong reſemblance among individuals of the ſame ſpecies, prevents almoſt entirely the effect of novelty, unleſs diſtance of place or ſome other circumſtance concur; but where the reſemblance is faint, ſome degree of wonder is felt, and the emotion riſes in proportion to the faintneſs of the reſemblance.

The higheſt degree of wonder ariſeth from unknown objects that have no analogy to any ſpecies we are acquainted with. Shakeſpeare in a ſimile introduces that ſpecies of novelty:

> As glorious to the ſight
> As is a winged meſſenger from heaven
> Unto the white up-turned wond'ring eye
> Of mortals, that fall back to gaze on him,
> When he beſtrides the lazy pacing clouds,
> And ſails upon the boſom of the air.
>
> *Romeo and Juliet.*

One example of that ſpecies of novelty deſerves peculiar attention; and that is, when an object altogether new is ſeen by one perſon only, and but once. Theſe circumſtances heighten remarkably the emotion: the ſingularity of the ſpectator concurs with the ſingularity of the object, to inflame wonder to its higheſt pitch.

In explaining the effects of novelty, the place a being occupies in the ſcale of exiſtence, is a circumſtance that muſt not be omitted. Novelty in the individuals of a low claſs is perceived with indifference, or with a very ſlight emotion: thus a pebble, however ſingular in its appearance, ſcarcely moves our wonder. The emotion riſes with the rank of the object; and, other circumſtances being equal, is ſtrongeſt in the higheſt order of exiſtence; a ſtrange inſect affects us more than a ſtrange vegetable; and a ſtrange quadruped more than a ſtrange inſect.

However natural novelty may be, it is a matter of experience, that thoſe who reliſh it the moſt are careful to conceal its influence. Love of novelty, it is true prevails in children, in idlers, and in men of ſhallow underſtanding: and yet, after all, why ſhould one be aſhamed of indulging a natural propenſity? A diſtinction will afford a ſatisfactory anſwer. No man is aſhamed of curioſity when it is indulged to acquire knowledge. But to prefer any thing merely becauſe it is new, ſhows a mean taſte which one ought to be aſhamed of: vanity is commonly at the bottom, which leads thoſe who are deficient in taſte to prefer things odd, rare, or ſingular, in order to diſtinguiſh themſelves from others. And in fact, that appetite, as above mentioned, reigns chiefly among perſons of a mean taſte, who are ignorant of refined and elegant pleaſures.

Of this taſte we have ſome memorable inſtances in men of the higheſt and the beſt education. Lucian tells the following ſtory of Ptolemy I. which is as diſgraceful to him, as honourable to his ſubjects. This prince had ranſacked the world for two curioſities; one was a camel from Bactria all over black; the other a man, half black half white. Theſe he preſented to the people in a public theatre, thinking they would give them as much ſatisfaction as they did him; but the black monſter, inſtead of delighting them, affrighted them; and the party-coloured man raiſed the contempt of ſome and the abhorrence of others. Ptolemy, finding the Egyptians preferred ſymmetry and beauty to

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A third may be added not leſs memorable. In the year 846, an obſtinate battle was fought between Xamire king of Leon and Abdoulrahman the Mooriſh king of Spain. After a very long conflict the night only prevented the Arabians from obtaining a complete victory. The king of Leon, taking advantage of the darkneſs, retreated to a neighbouring hill, leaving the Arabians maſters of the field of battle. Next morning, perceiving that he could not maintain his place for want of proviſions, nor be able to draw off his men in the face of a victorious army, he ranged his men in order of battle, and, without loſing a moment, marched to attack the enemy, reſolving to conquer or die. The Arabians, aſtoniſhed to be attacked by thoſe who were conquered the night before, loſt all heart: fear ſucceeded to aſtoniſhment, the panic was univerſal, and they all turned their backs without almoſt drawing a ſword.

to the most astonishing productions of art or nature without them, wisely removed his two enormous trifles out of sight; the neglected camel died in a little time, and the man he gave for a song to the musician Thespis.

One final cause of wonder, hinted above, is, that this emotion is intended to stimulate our curiosity. Another, somewhat different, is, to prepare the mind for receiving deep impressions of new objects. An acquaintance with the various things that may affect us, and with their properties, is essential to our well-being: nor will a slight or superficial acquaintance be sufficient; they ought to be so deeply engraved on the mind, as to be ready for use upon every occasion. Now, in order to a deep impression, it is wisely contrived, that things should be introduced to our acquaintance with a certain pomp and solemnity productive of a vivid emotion. When the impression is once fairly made, the emotion of novelty being no longer necessary, vanisheth almost instantaneously; never to return, unless where the impression happens to be obliterated by length of time or other means; in which case the second introduction hath nearly the same solemnity with the first.

Designing wisdom is nowhere more eligible than in this part of the human frame. If new objects did not affect us in a very peculiar manner, their impressions would be so slight as scarce to be of any use in life: on the other hand, did objects continue to affect us as deeply as at first, the mind would be totally engrossed with them, and have no room left either for action or reflection.

The final cause of surprise is still more evident than of novelty. Self-love makes us vigilantly attentive to self-preservation; but self-love, which operates by means of reason and reflection, and impels not the mind to any particular object or from it, is a principle too cool for a sudden emergency; an object breaking in unexpectedly, affords no time for deliberation; and in that case, the agitation of surprise comes in seasonably to rouse self-love into action: surprise gives the alarm; and if there be any appearance of danger, our whole force is instantly summoned to shun or to prevent it.

NOVELLARA, a handsome town of Italy, and capital of a small district of the same name, with a handsome castle, where their sovereign resides. E. Long. 10. 37. N. Lat. 45. 50.

NOVEMVIRI, nine magistrates of Athens, whose government lasted but for one year. The first of whom was called *archon*, or prince; the second *basilius*, or king; the third *polemarchus*, or general of the army: the other six were called *thesmothetæ*, or lawgivers. They took an oath to observe the laws; and in case of failure, obliged themselves to bestow upon the commonwealth a statue of gold as big as themselves. Those who discharged their office with honour, were received into the number of the senators of Areopagus.

NOVI, a town of Italy, in the territory of Genoa, on the confines of the Milanese. It was taken by the Piedmontese in 1746. E. Long. 8. 48. N. Lat. 44. 45.

NOVI Bazar, a considerable town of Turkey in Europe, and in Servia, near the river Oresco. E. Long. 20. 24. N. Lat. 43. 25.

NOVICE, a person not yet skilled or experienced in an art or profession.

In the ancient Roman militia, *novicii*, or *novitii*, were the young raw soldiers, distinguished by this appellation from the veterans.

In the ancient orders of knighthood, there were novices, or clerks in arms, who went through a kind of apprenticeship ere they were admitted knights.—See KNIGHT.

NOVICE is more particularly used in monasteries for a religious yet in his, or her, year of probation, and who has not made the vows.

In some convents, the sub-prior has the direction of the novices. In nunneries, the novices wear a white veil; the rest a black one.

NOVICIATE, a year of probation appointed for the trial of religious, whether or no they have a vocation, and the necessary qualities for living up to the rule; the observation whereof they are to bind themselves to by vow. The novitiate lasts a year at least; in some houses more. It is esteemed the bed of the civil death of a novice, who expires to the world by profession.

NOVIGRAD, a small but strong town of Upper Hungary, capital of a county of the same name, with a good castle, seated on a mountain near the Danube, E. Long. 18. 10. N. Lat. 40. 50.

NOVIGRAD, a small but strong town of Dalmatia, with a castle, and subject to the Turks; seated on a lake of the same name, near the gulf of Venice. E. Long. 16. 45. N. Lat. 44. 30.

NOVIGRAD, a very strong place of Servia, subject to the Turks; seated near the Danube. E. Long. 26. 5. N. Lat. 45. 5.

NOVIODUNUM (Cæsar), a town of the Ædui, commodiously seated on the Liguris: the *Nivernum* of Antonine. Now *Nevers* in the Orleannois, on the Loire.—A second *Noviodunum* of the Aulerci Diablintes, in Gallia Celtica, (Antonine); called *Noviodunum* (Ptolemy), and *Noningentum Rotrudum* by the moderns: *Nogente le Rotrou*, capital of the duchy of Perche.—A third of the Bituriges, (Cæsar): Now *Nueve sur Baranion*; a village 15 miles to the north of Bourges, towards Orleans.—A fourth, of Mœsia Inferior, (Ptolemy), situated on the Ister: now *Nivorz*, in Bessarabia.—A fifth, of Pannonia Superior, (Antonine; now *Gurkfeld* in Carinthia.—A sixth, *Noviodunum Suessionum*, the same with *Augusta Suessionum*.—A seventh, *Noviodunum* of the Veromandui in Gallia Belgica, (Cæsar): now *Noyon* in the Isle of France, on the borders of Picardy.

NOUN, see GRAMMAR, N° 7.; and Chapter I. *in toto*.

NOVOGOROD WELICKI, *Great Novogorod*, according to Mr Coxe, is one of the most ancient cities in Russia. It was formerly called *Great Novogorod*, to distinguish it from other Russian towns of a similar appellation; and now presents to the attentive and intelligent traveller a striking instance of fallen grandeur. According to Nestor, the earliest of the Russian historians, it was built at the same time with Kiof, namely, in the middle of the 5th century, by a Sclavonian horde, who, according to Procopius, issued from the banks of the Volga. Its antiquity is clearly proved

proved by a paſſage in the Gothic hiſtorian Jornandes, in which it is called *Civitas Nova*, or new town. We have little inſight into its hiſtory before the ninth century, when Ruric the firſt great duke of Ruſſia reduced it, and made it the metropolis of his vaſt dominion. The year ſubſequent to his death, which happened in 879, the ſeat of government was removed, under his ſon Igor, then an infant, to Kiof; and Novogorod continued, for above a century, under the juriſdiction of governors nominated by the great dukes, until 970, when Svatoſlaf, the ſon of Igor, created his third ſon Vladimir duke of Novogorod: the latter, ſucceeding his father in the throne of Ruſſia, ceded the town to his ſon Yaroſlaf, who in 1036 granted to the inhabitants very conſiderable privileges, that laid the foundation of that extraordinary degree of liberty which they afterwards gradually obtained. From this period Novogorod was for a long time governed by its own dukes: theſe ſovereigns were at firſt ſubordinate to the great dukes, who reſided at Kiof and Volodimir; but afterwards, as the town increaſed in population and wealth, they gradually uſurped an abſolute independency. Its independency, however, was not perpetual. It continued, indeed, in a flouriſhing ſtate until the middle of the 15th century: but the great dukes of Ruſſia, whoſe anceſtors had reigned over this town, and who ſtill retained the title of dukes of Novogorod, having transferred their reſidence from Kiof to Volodimir, and afterwards to Moſcow, laid claim to its feudal ſovereignty; a demand which the inhabitants ſometimes put off by compoſition, ſometimes by reſiſtance, but were ſometimes compelled to acknowledge. At length, however, the great duke became abſolute ſovereign of Novogorod, though the oſtenſible forms of government were ſtill preſerved. It even then, however, continued to be the largeſt and moſt commercial city of Ruſſia; a proof of which we have as late as the year 1554, from the following deſcription of Richard Chancellor, who paſſed through it in 1554 in his way to Moſcow. "Next unto Moſcow, the city of Novogord is reputed the chiefeſt of Ruſſia; for although it be in majeſty inferior to it, yet in greatneſs it goeth beyond it. It is the chiefeſt and greateſt mart town of all Muſcovy; and albeit the emperor's ſeat is not there, but at Moſcow, yet the commodiouſneſs of the river, falling into that gulf which is called Sinus Finnicus, whereby it is well frequented by merchants, makes it more famous than Moſcow itſelf." An idea of its population during this period, when compared with its preſent declined ſtate, is manifeſt from the fact, that in 1508 above 15,000 perſons died of an epidemical diſorder; more than double the number of its preſent inhabitants. In its moſt flouriſhing condition it contained at leaſt 400,000 ſouls. Its ruin was brought on by Ivan Vaſilievitch II. and completed by the foundation of Peterſburgh. The preſent town is ſurrounded by a rampart of earth, with a range of old towers at regular diſtances, forming a circumference of ſcarcely a mile and a half; and even this inconſiderable circle includes much open ſpace, and many houſes which are not inhabited. As Novogorod was built after the manner of the ancient towns in this country, in the Aſiatic ſtyle, this rampart, like that of the Semlainogorod at Moſcow, probably encloſed ſeveral interior circles. Without it was a vaſt extenſive ſuburb, which reached to the diſtance of ſix miles, and included within its circuit all the convents and churches, the ancient ducal palace and other ſtructures, that now make a ſplendid but ſolitary appearance, as they lie ſcattered in the adjacent plain.

Novogorod ſtretches on both ſides of the Volkof, a beautiful river of conſiderable depth and rapidity, and ſomewhat broader than the Thames at Windſor. This river ſeparates the town into two diviſions, the trading part, and the quarter of St Sophia, which are united by means of a bridge, partly wooden and partly brick.

NOVOGOROD Welicki, a province of Muſcovy, bounded on the north by Ingria; on the eaſt by part of the duchy of Belozero, and that of Tuera, which alſo bounds it on the ſouth, with the province of Rzeva; and on the weſt by Pleſcow. It is full of lakes and foreſts; however, there are ſome places which produce corn, flax, hemp, honey, and wax.

NOVOGOROD Serpſkoi, a ſtrong town of the Ruſſian empire, and capital of a province of Siberia of the ſame name, ſeated on the river Dubica, in E. Long. 33. 20. N. Lat. 52. 30.

NOVOGORODECK, a town of Lithuania, and capital of a palatinate of the ſame name. It is a large place, and ſituated in a vaſt plain, in E. Long. 25. 30. N. Lat. 53. 45.

NOURISHMENT. See NUTRITION.

NOURISHMENT of Vegetables. See AGRICULTURE *Index*.

NOWED, in *Heraldry*, ſignifies "knotted," from the Latin *nodatus*; being applied to the tails of ſuch creatures as are very long, and ſometimes repreſented in coat armour as tied up in a knot.

NOX, in fabulous hiſtory, one of the moſt ancient deities among the heathens, daughter of Chaos. From her union with her brother Erebus, ſhe gave birth to the Day and the Light. She was alſo the mother of the Parcæ, Heſperides, Dreams, of Diſcord, Death, Momus, Fraud, &c. She is called by ſome of the poets the mother of all things, of gods as well as of men; and ſhe was worſhipped with great ſolemnity by the ancients. She had a famous ſtatue in Diana's temple at Epheſus. It was uſual to offer her a black ſheep, as ſhe was the mother of the Furies. The cock was alſo offered to her, as that bird proclaims the approach of day during the darkneſs of the night. She is repreſented as mounted on a chariot, and covered with a veil beſpangled with ſtars. The conſtellations generally went before her as her conſtant meſſengers. Sometimes ſhe is ſeen holding two children under her arms; one of which is black, repreſenting Death, and the other white, repreſenting Sleep. Some of the moderns have deſcribed her as a woman veiled in mourning, and crowned with poppies, and carried on a chariot drawn by owls and bats.

NOYON, a town of France, ſituated on the declivity of a hill on the rivulet Vorſe, which at a quarter of a league's diſtance falls into the Oyſe, in the department of Oyſe, in E. Long. 3. 0. N. Lat. 49. 38. about 66 miles north-eaſt of Paris. It is an ancient place, being the *Noviodunum Belgarum* of the Latins. It is a pretty large city, and is well ſituated for inland trade, which conſiſts here in wheat and oats, which they ſend to Paris.

Noyon ‖ Nuba.

Paris. They have alſo manufactories of linen cloths, lawns, and tanned leather. There are eight pariſhes in it, two abbeys, and ſeveral monaſteries of both ſexes. It is the ſee of a biſhop, ſuffragan to the metropolitan of Rheims; he has the title of count and peer of France, and his income is ſaid to amount to about 15,000 livres per annum. The principal buildings are the epiſcopal palace, a cloiſter where the canons of the cathedral dwell, and the town-houſe. The latter is regularly built in a large ſquare, in the middle of which there is a fountain, where the water conveyed to it from a neighbouring mountain runs continually through three conduits, and is received in a large baſon built of very hard ſtone. They have alſo many other fountains, ſeveral market places, and two public gardens. Noyon is particularly remarkable for the birth of the famous John Calvin, who was born here on the 10th of July 1502, and died at Geneva the 27th of May 1564.

NUAYHAS, the AGUE TREE; a name given by the Indians to a ſort of bamboe cane, the leaves of which falling into the water, are ſaid to impregnate it with ſuch virtue, that the bathing in it afterwards cures the ague. They uſe alſo a decoction of the leaves to diſſolve coagulated blood, giving it internally, and at the ſame time rubbing the bruiſed part externally with it. It is ſaid that this plant bears its flowers only once in its life; that it lives 60 years before thoſe make their appearance; but that when they begin to ſhow themſelves, it withers away in about a month afterwards; that is, as ſoon as it has ripened the ſeed. There ſeems to be ſomething of fiction in the account of many other particulars relating to this tree in the *Hortus Malabaricus;* but it ſeems certain, that the length of the ſtalks, or trunk, muſt be very great: for, in the gallery of Leyden, there is preſerved a cane of it 28 feet long; and another not much ſhorter in the Aſhmolean muſeum at Oxford, and which is more than eight inches in diameter: yet both theſe appear to be only parts of the whole trunk, they being nearly as large at one end as at the other.

NUBA, a race of black Pagans, in the neighbourhood of Sennaar, of whom we know nothing but what we have learned from Mr Bruce. That celebrated traveller paſſed a day or two among them, in his way from Abyſſinia; and he tells us, that they are all ſoldiers of the *Mek* or king of Sennaar, cantoned in villages, which to the diſtance of four or five miles ſurround the capital. They are not the aborigines of that part of Africa; but "are either purchaſed or taken by force from Fazuclo, and the provinces to the ſouth upon the mountains Dyre and Tegla." Though the ſlaves of a cruel and treacherous maſter, Mr Bruce repreſents them as a gentle, honeſt, and hoſpitable people; and he ſays expreſsly, that on a journey he had ſeldom paſſed a more comfortable night, than one in which he took refuge from a ſtorm in a village of thoſe Nuba. He had a good ſupper, and a clean neat hut to ſleep in, while ſome of the Nuba watched for him all night, and took care of his beaſts and his baggage. "Having ſettlements and proviſions given them by the government of Sennaar, as alſo arms put into their hands, they never wiſh to deſert, but live a very domeſtic and ſober life, and are a much gentler ſort of negro than their maſters." (See SENNAAR.) Though the

Nuba.

eſtabliſhed religion of Sennaar is that of Mahomet, the government has never attempted to convert the Nuba. On the contrary, a certain number of Pagan prieſts is maintained for them in every village, who have ſoldiers in pay to aſſiſt them in the affairs of their religion. This is a very ſingular inſtance of toleration among Mahometans, and what we ſhould little have expected from ſuch barbarous and ſanguinary wretches as thoſe who have the ſupreme power in Sennaar, had not our obſerving traveller informed us, that theſe men themſelves know almoſt nothing of the religion which they profeſs, and are in their hearts rather Pagans than Mahometans.

The idolatry of the Nuba is deſcribed as a mixture of Sabiiſm and ſtatue worſhip: but what is very uncommon, their worſhip is chiefly paid to the moon, while they pay no attention to the ſun either riſing or ſetting, advancing to the meridian or receding from it. It is an old obſervation, that the worſhip of every people is tinctured by their natural diſpoſitions; and this is verified in the Nuba. "That their worſhip is performed with pleaſure and ſatisfaction, is obvious (ſays our author) every night that the moon ſhines. Coming out from the darkneſs of their huts, they ſay a few words upon ſeeing her brightneſs, and teſtify great joy, by motions of their feet and hands, at the firſt appearance of the new moon." This is juſt what we ſhould have expected from their gentleneſs and hoſpitality. They worſhip likewiſe a tree and a ſtone; but our author could never diſcover what tree or ſtone; only he learned that neither of them exiſts in Sennaar, but in the country where the Nuba are born. Such of them as are natives of the villages where he ſaw them, become, like their maſters, nominal Mahometans.—The reſt practiſe the idolatrous worſhip of their anceſtors, and are much under the influence of their prieſts, from fear rather than from affection. They are immoderately fond of ſwine's fleſh, and maintain great herds of ſmall hogs, marked with black and white ſpots. Few of the Nuba advance higher than to be ſoldiers and officers in their own corps; and the Mek maintains about 12,000 of them near Sennaar to keep the Arabs in ſubjection. In a climate ſo violent as that which they inhabit, there is very little need of fuel; and it is happy for them that ſuch is the caſe, for in the whole country there is not a ſingle tree, or turf, or any thing reſembling it. They do not, however, "eat their meat raw like the Abyſſinians; but with the ſtalk of the dora or millet, and the dung of camels, they make ovens under ground, in which they roaſt their hogs whole, in a very cleanly manner, keeping their ſkins on till they are perfectly baked. They have neither flint nor ſteel with which to light their fire at firſt; but do it in a manner ſtill more expeditious, by means of two ſticks, brought, we are led to think, from Sennaar, and there picked out of the river when flooded. They make a ſmall hole in one of theſe ſticks, and point the other: then laying the former in a horizontal poſition, they apply the point of the latter to the hole; and, turning the perpendicular ſtick between their hands, as we do a chocolate mill, both ſticks take fire and flame in a moment; ſo perfectly dry and prepared to take fire is every thing there on the ſurface of the earth."

NUBECULA,

Nubecula || Nubia.

NUBECULA, LITTLE CLOUD, in *Medicine*, a term ſometimes uſed for a diſeaſe in the eye, wherein objects appear as through a cloud or miſt.

The nubecula ſeems to ariſe from certain groſs particles detained in the pores of the cornea, or ſwimming in the aqueous humour, and thus intercepting the rays of light.

NUBECULA, or *Nubes*, is alſo uſed for what is otherwiſe called *albugo*. See ALBUGO.

NUBECULA is uſed likewiſe for a matter in form of a cloud, ſuſpended in urine.

NUBIA, a kingdom of Africa, bounded on the north by Egypt, on the eaſt by the Red ſea and part of Abyſſinia, on the weſt by the kingdoms of Tagua, Gaoga, and the deſert of Gerham. The river Nile runs through it; on the banks of which, and thoſe of the other rivers, it is pretty fruitful, but in other places barren, ſandy, and in want of water. To the weſt of the Nile is the deſert of Bahouda, which is five days journey over, being the uſual road from Egypt to Abyſſinia. Money is of no uſe in this country in the way of trade, it being all carried on by way of exchange. Their bread and drink is made of a ſmall round ſeed, called *doca* or *ſeff*, which is very ill taſted. Their houſes have mud walls, being very low, and covered with reeds. The habit of the better ſort is a veſt without ſleeves; and they have no coverings for their heads, legs, and feet. The common people wrap a piece of linen cloth about them, and the children go quite naked. They are a ſtupid debauched ſort of people, having neither modeſty, civility, nor religion, though they profeſs to be Mahometans.—The productions of this country are gold, elephants teeth, civet, and ſandal wood; and they ſend a great many ſlaves into Egypt. The principal towns known to the Europeans are Dangola and Sennaar.

It is famous for a race of horſes the moſt powerful and docile in the world. Theſe animals are generally about ſixteen hands high; and by Mr Bruce, who has given the moſt ſcientific account of them, they are ſaid to be the breed which was introduced into Nubia at the Saracen conqueſt, and has been preſerved unmixed to this day. Our author repreſents this as a much nobler animal than the Arabian horſe. "What figure (ſays he *) the Nubian horſe would make in point of fleetneſs is very doubtful, his make being ſo entirely different from that of the Arabian; but if beautiful ſymmetry of parts, great ſize and ſtrength, the moſt agile, nervous, and elaſtic movements, great endurance of fatigue, docility of temper, and ſeeming attachment to men beyond that of any other domeſtic animal, can promiſe any thing for a ſtallion, the Nubian is above all compariſon the moſt eligible in the world." He thinks, and juſtly thinks, that an attempt ſhould at leaſt be made to import them into this kingdom. "The expence (he ſays) would not be great, though there might be ſome trouble and application neceſſary: but if adroitly managed, there would not be much even of that. The Nubians are very jealous in keeping up the pedigree of their horſes, which are black or white, but a vaſt proportion of the former to the latter." Our author never ſaw the colour which we call gray, i. e. dappled; but he has ſeen ſome bright bays, and ſome inclined to ſorrel. All noble horſes in Nubia are ſaid to be deſcended of one of the five upon which Mahomet and his four immediate ſucceſſors, Abu Becr, Omar, Atmen, and Ali, fled from Mecca to Medina the night of the Hegira. No one will pay much regard to this legendary tale, or believe that the ſtrength and beauty of this breed of horſes is owing to any virtue communicated to the firſt of them by the prophet and his apoſtles. Mr Bruce accounts for their excellence upon rational principles. "The beſt horſes of the Arabian breed are found (he ſays) in the tribe of Mowelli and Annecy, which is about 36° north latitude. Dangola, which is in 20° latitude, ſeemed to him to be the centre of excellence for this noble animal." Hence he infers, that the bounds in which the horſe is in greateſt perfection, are between the 20th and 36th degrees of latitude, and between 30 degrees of longitude eaſt from Greenwich and the banks of the Euphrates. If to the effects of climate we add the manner of feeding the Nubian horſes, we ſhall perhaps have the true cauſe of their ſuperiority over all others. "They are kept fat upon dora, and ſuffered to eat nothing green but the ſhort roots of graſs that are to be found by the ſide of the Nile, after the ſun has withered it. This is dug out where it is covered with earth, and appears blanched, and laid in ſmall heaps once a-day on the ground before them."

* *Travels*, vol. iv. b. 8. ch. 10.

NUBIAN DESERT, a vaſt tract of barren rocks and burning ſands, extending from Syene in Upper Egypt to Geon the capital of Berber in Nubia. As Syene is in latitude 24° 0′ 45″ north, and Geon in latitude 17° 57′ 22″, the length of this deſert from north to ſouth is 6° 3′ 23″, or upwards of 420 Engliſh miles. Its breadth from eaſt to weſt has not, as far as we know, been preciſely aſcertained. Through this horrid region, where nothing is to be ſeen which has the breath of life, muſt all travellers paſs from Sennaar to Egypt; in danger every moment of periſhing by thirſt, being overwhelmed by moving columns of ſand, ſuffocated by a hot and poiſonous wind, or cut in pieces by troops of wandering Arabs. The laſt European of whom we have heard that made the journey and lived to give an account of it, is Mr Bruce; and the perſon muſt have neither taſte nor ſenſibility who can read unmoved his manly narrative.

No ſingle traveller, nor even a caravan, can enter with ſafety into this deſert, but under the protection of a Hybear; whoſe title and office are thus explained by Mr Bruce: "A Hybear is a guide, from the Arabic word *Hubbar*, which ſignifies to inform, inſtruct, or direct, becauſe they are uſed to do this office to the caravans travelling through the deſert in all directions. They are men of great conſideration, knowing perfectly the ſituation and properties of all kinds of water to be met with on the route, the diſtance of wells, whether occupied by enemies or not; and if ſo, the way to avoid them with the leaſt inconvenience. It is alſo neceſſary that they ſhould know the places occupied by the Simoom, and the ſeaſons of its blowing (ſee SIMOOM), as well as thoſe occupied by moving ſands."—Under the conduct of one of theſe men, Mr Bruce, with infinite fortitude and addreſs, paſſed through the deſert in the year 1772, ſurmounting dangers at which one ſhudders in his cloſet. Of theſe, the following, which we ſhall give in the nervous language of the author, may ſerve as an inſtance.

"We were here (at a place called *Weadi al Halboub*) at at once surprised and terrified by a sight surely one of the most magnificent in the world. In that vast expanse of desert, from W. and to NW, of us, we saw a number of prodigious pillars of sand at different distances, at times moving with great celerity, at others stalking on with a majestic slowness. At intervals we thought they were coming in a very few minutes to overwhelm us; and small quantities of sand did actually more than once reach us. Again they would retreat so as to be almost out of sight; their tops reaching to the very clouds. There the tops often separated from the bodies; and these once disjoined, dispersed in the air, and did not appear more. Sometimes they were broken in the middle as if struck with a large cannon shot. About noon they began to advance with considerable swiftness upon us, the wind being very strong at north. Eleven, of them ranged alongside of us about the distance of three miles. The greatest diameter of the largest appeared to me at that distance as if it would measure 10 feet. They retired from us with a wind at SE. leaving an impression upon my mind to which I can give no name; though surely one ingredient in it was fear, with a considerable degree of wonder and astonishment."

If it be true, as the author of A Philosophical Inquiry into the Origin of our Ideas of the Sublime and Beautiful affirms, that "the passion raised by the sublime is astonishment, and that astonishment is that state of the soul in which all its motions are suspended with some degree of horror," surely a more sublime spectacle was never presented to mortal eyes, than that which was on this occasion presented to Mr Bruce. It must have been awfully majestic; but few, we believe, would choose the pleasure of contemplating such a scene of magnificence at the hazard of that dreadful death with which at every moment it threatened our traveller and his attendants. He, indeed, had firmness of mind to stand still and admire it; but his companions shrieked out; while some of them exclaimed that it was the day of judgement, and others that it was hell or the world set on fire. But for a more particular account of this phenomenon, as well as of the nature of the desert and the proper way of passing it, we must refer to the work from which this short sketch is taken †.

† Bruce's Travels, vol. iv.

NUCLEUS, in general, denotes the kernel of a nut, or even any seed enclosed within a husk. The term *nucleus* is also used for the body of a comet, otherwise called its *head*.

NUCTA, a dew, which falling in Egypt about St John's day, is by the superstitious natives of the country considered as miraculous, and the peculiar gift of that saint. Its effects are indeed so beneficial, that this belief is little surprising among a people so totally ignorant of natural causes as the modern Egyptians, for it is acknowledged, by the most enlightened travellers, to stop the plague, and announce a speedy and plentiful inundation of the country. These effects are thus rationally accounted for by Mr Bruce.

"In February and March, the sun is on its approach to the zenith of one extremity of Egypt, and of course has a very considerable influence upon the other. The Nile having now fallen low, the water in certain old cisterns, which, though they still exist, are suffered to accumulate all the filth of the river, becomes putrid, and the river itself has lost all its finer and volatile parts by the continued action of a vertical sun; so that instead of being subject to evaporation, it grows daily more and more inclined to putrefaction. About St John's day it receives a plentiful mixture of the fresh and fallen rain from Ethiopia, which dilutes and refreshes the almost corrupted river, and the sun near at hand exerts its influence upon the water, which is now become light enough to be exhaled, though it has still with it a mixture of the corrupted fluid. It is in February, March, or April only, that the plague begins in Egypt." Our philosophical traveller does not believe it an endemical disease; but assigns very sufficient reasons for thinking that it comes from Constantinople with merchandise or with passengers at the very time of the year when the air, by the long absence of dews, has attained a degree of putridity proper to receive it. In this state of the atmosphere, the infection continues to rage till the period of St John's day, when it is suddenly stopped by the dews occasioned by a refreshing mixture of rain water, which is poured into the Nile at the beginning of the inundation. The first and most remarkable sign of the change effected in the air, is the sudden stopping of the plague. Every person, though shut up from society for months before, buys, sells, and communicates with his neighbour without any sort of apprehension; and as far as our author could learn upon fair inquiry, it was never known that one fell sick of the plague after the anniversary of St John. He admits that some have died of it after that period; but of them the disease had got such hold, under the most putrid influence of the air, that they could not recover. To corroborate this theory, which attributes so much to the benign influence of the falling dew, he observes, that immediately after St John's day, the clothes of the many thousands who have died during the late continuance of the plague are publicly exposed in the market place; and that all these, though consisting of furs, cotton, silk, and woollen cloths, which are the stuffs most retentive of infection, imbibing the moist air of the evening and the morning, are handled, bought, put on and worn, without any apprehension of danger, and without a single accident being known to have happened to any one possessed of this happy confidence.

NUDITIES, in painting and sculpture, those parts of an human figure which are not covered with any drapery; or those parts where the carnation appears.

NULLITY, in *Law*, signifies any thing that is null or void: thus there is a nullity of marriage, where persons marry within the degrees, or where infants marry without consent of their parents or guardians.

NUMA POMPILIUS, the fourth son of Pompilius Pompo, an illustrious Sabine. He had married Tatia, the daughter of King Tatius, and together with her remained in his native country, preferring the tranquillity of a private life to the splendour of a court. Upon the death of his wife, with whom he had lived thirteen years, he gave himself up entirely to the study of wisdom; and, leaving the city of Cures, confined himself to the country, wandering from solitude to solitude, in search only of those woods and fountains which religion had made sacred. His recluse life gave rise to the fable, which was very early received among the Sabines, that Numa lived in familiarity with the nymph Egeria. Upon the death of Romulus, both the

Numa. senate and people strongly solicited him to be their king. They despatched Julius Proculus and Valerius Volesus, two senators of distinction, to acquaint Numa with their resolution, and make him an offer of the kingdom. The Sabine philosopher rejected at first their proposal; but being at last prevailed upon by the arguments and entreaties of the deputies, joined with those of his father and of Martius his near relation, he yielded; and having offered sacrifices to the gods, set out for Rome, where he was received by all ranks of people with loud shouts of joy. Spurius Vettius, the interrex for the day, having assembled the curiæ, he was elected in due form, and the election was unanimously confirmed by the senate.

The beginning of his reign was popular; and he dismissed the 300 bodyguards which his predecessor had kept around his person, and observed, that he did not distrust a people who had compelled him to reign over them. He was not, like Romulus, fond of war and military expeditions, but he applied himself to tame the ferocity of his subjects, to inculcate in their minds a reverence for the Deity, and to quell their dissensions by dividing all the citizens into different classes. He established different orders of priests, and taught the Romans not to worship the Deity by images; and from his example no graven or painted statues appeared in the temples or sanctuaries of Rome for the space of 160 years. He encouraged the report that was spread of his paying regular visits to the nymph Egeria, and made use of her name to give sanction to the laws and institutions which he had introduced. He established the college of the vestals, and told the Romans that the safety of the empire depended upon the preservation of the sacred *ancyle* or shield, which, as was generally believed, had dropped from heaven. He dedicated a temple to Janus, which, during his whole reign, remained shut as a mark of peace and tranquillity at Rome. After a reign of 42 years, in which he had given every possible encouragement to the useful arts, and in which he had cultivated peace, Numa died in the year of Rome 82. Not only the Romans, but also the neighbouring nations, were eager to pay their last offices to a monarch whom they revered for his abilities, moderation, and humanity. He forbade his body to be burnt according to the custom of the Romans; but he ordered it to be buried near Mount Janiculum, with many of the books which he had written. These books were accidentally found by one of the Romans, about 400 years after his death; and as they contained nothing new or interesting, but merely the reasons why he had made innovations in the form of worship and in the religion of the Romans, they were burnt by order of the senate. He left behind him one daughter called Pompilia, who married Numa Marcius, and became the mother of Ancus Marcius the fourth king of Rome. Some say that he had also four sons; but this opinion is ill founded. The principal laws of King Numa, mentioned by different authors, are, 1. That the gods should be worshipped with corn and a salted cake. 2. That whoever knowingly killed a free man, should be held as a parricide. 3. That no harlot should touch the altar of Juno; and if she did, that she should sacrifice a ewe-lamb to that goddess, with dishevelled hair. 4. That whoever removed a land-mark should be put to death. 5. That wine should not be poured on a funeral pile, &c.

Numantia, Number. NUMANTIA, a very noble city, the ornament of the Hither Spain, (Florus); celebrated for the long war of 20 years which it maintained against the Romans. The baseness and injustice of the Romans during this war were truly disgraceful to them, and altogether unworthy of a great and powerful people. The inhabitants obtained some advantages over the Roman forces, till Scipio Africanus was empowered to finish the war and to see the destruction of Numantia. He began the siege, with an army of 60,000 men, and was bravely opposed by the besieged, who were no more than 4000 men able to bear arms. Both armies behaved with uncommon valour, and the courage of the Numantines was soon changed into despair and fury. Their provisions began to fail, and they fed upon the flesh of their horses, and afterwards on that of their dead companions, and at last they were obliged to draw lots to kill and devour one another. The melancholy situation of their affairs obliged them to surrender to the Roman general. Scipio demanded them to deliver themselves up on the morrow; they refused, and when a longer time had been granted to their petitions, they retired and set fire to their houses and destroyed themselves, so that not even one remained to adorn the triumph of the conqueror. Some historians, however, deny that; and assert, that a number of Numantines delivered themselves into Scipio's hands, and that 50 of them were drawn in triumph at Rome, and the rest sold as slaves. The fall of Numantia was more glorious than that of Carthage or Corinth, though the place was much inferior to them. It was taken by the Romans, A. U. C. 629; and the conqueror obtained the surname of *Numanticus*.

NUMBER, an assemblage of several units, or things of the same kind. See Arithmetic, and Metaphysics, N° 205—208.

Number, says Malcolm, is either abstract or applicate: Abstract, when referred to things in general, without attending to their particular properties; and applicate, when considered as the number of a particular sort of things, as yards, trees, or the like.

When particular things are mentioned, there is always something more considered than barely their numbers; so that what is true of numbers in the abstract, or when nothing but the number of things is considered, will not be true when the question is limited to particular things: for instance, the number two is less than three; yet two yards is a greater quantity than three inches: and the reason is, because regard must be had to their different natures as well as number, whenever things of a different species are considered; for though we can compare the number of such things abstractedly, yet we cannot compare them in any applicate sense. And this difference is necessary to be considered, because upon it the true sense, and the possibility or impossibility, of some questions depend.

Number is unlimited in respect of increase; because we can never conceive a number so great but still there is a greater. However, in respect of decrease, it is limited; unity being the first and least number, below which therefore it cannot descend.

Kinds

Number.

Kinds and distinctions of NUMBERS. Mathematicians, considering number under a great many relations, have established the following distinctions.

Broken numbers are the same with fractions.

Cardinal numbers are those which express the quantity of units, as 1, 2, 3, 4, &c. whereas ordinal numbers are those which express order, as 1st, 2d, 3d, &c.

Compound number, one divisible by some other number besides unity; as 12, which is divisible by 2, 3, 4, and 6. Numbers, as 12 and 15, which have some common measure besides unity, are said to be compound numbers among themselves.

Cubic number is the product of a square number by its root: such is 27, as being the product of the square number 9 by its root 3. All cubic numbers, whose root is less than 6, being divided by 6, the remainder is the root itself; thus $27 \div 6$ leaves the remainder 3, its root; 215, the cube of 6, being divided by 6, leaves no remainder; 343, the cube of 7, leaves a remainder 1, which added to 6, is the cube root; and 512, the cube of 8, divided by 6, leaves a remainder 2, which added to 6, is the cube root. Hence the remainders of the divisions of the cubes above 216, divided by 6, being added to 6, always give the root of the cube so divided till that remainder be 5, and consequently 11, the cube root of the number divided. But the cubic numbers above this being divided by 6, there remains nothing, the cube root being 12. Thus the remainders of the higher cubes are to be added to 12 and not to 6, till you come to 18, when the remainder of the division must be added to 18; and so on *ad infinitum*.

Determinate number is that referred to some given unit, as a ternary or three: whereas an indeterminate one is that referred to unity in general, and is called *quantity*.

Homogeneal numbers are those referred to the same unit; as those referred to different units are termed *heterogeneal*.

Whole numbers are otherwise called *integers*.

Rational number is one commensurable with unity; as a number, incommensurable with unity, is termed *irrational*, or a *surd*.

In the same manner, a rational whole number is that whereof unity is an aliquot part; a rational broken number, that equal to some aliquot part of unity; and a rational mixed number, that consisting of a whole number and a broken one.

Even number, that which may be divided into two equal parts without any fraction, as 6, 12, &c. The sum, difference, and product, of any number of even numbers, is always an even number.

An evenly even number, is that which may be measured, or divided, without any remainder, by another even number, as 4 by 2.

An unevenly even number, when a number may be equally divided by an uneven number, as 20 by 5.

Uneven number, that which exceeds an even number, at least by unity, or which cannot be divided into two equal parts, as 3, 5, &c.

The sum or difference of two uneven numbers makes an even number; but the factum of two uneven ones makes an uneven number.

If an even number be added to an uneven one: or if the one be subtracted from the other, in the former case the sum, in the latter the difference, is an uneven number; but the factum of an even and uneven number is even.

The sum of any even number of uneven numbers is an even number; and the sum of any uneven number of uneven numbers is an uneven number.

Primitive or prime numbers are those divisible only by unity, as 5, 7, &c. And prime numbers among themselves, are those which have no common measure besides unity, as 12 and 19.

Perfect number, that whose aliquot parts added together make the whole number, as 6, 28; the aliquot parts of 6 being 3, 2, and 1, $=6$; and those of 28, being 14, 7, 4, 2, 1, $=28$.

Imperfect numbers, those whose aliquot parts added together make either more or less than the whole. And these are distinguished into abundant and defective: an instance in the former case is 12, whose aliquot parts 6, 4, 3, 2, 1, make 16; and in the latter case 16, whose aliquot parts 8, 4, 2, and 1, make but 15.

Plane number, that arising from the multiplication of two numbers, as 6, which is the product of 3 by 2; and these numbers are called the *sides of the plane*.

Square number is the product of any number multiplied by itself; thus 4, which is the factum of 2 by 2, is a square number.

Even square number added to its root makes an even number.

Figurate numbers, are such as represent some geometrical figure, in relation to which they are always considered; as triangular, pentagonal, pyramidal, &c. numbers.

Figurate numbers are distinguished into orders, according to their place in the scale of their generation, being all produced one from another, viz. by adding continually the terms of any one, the successive sums are the terms of the next order, beginning from the first order which is that of equal units 1, 1, 1, 1, &c.; then the 2d order consists of the successive sums of those of the 1st order, forming the arithmetical progression 1, 2, 3, 4, &c.; those of the third order are the successive sums of those of the 2d, and are the triangular numbers 1, 3, 6, 10, 15, &c.; those of the 4th order are the successive sums of those of the 3d, and are the pyramidal numbers 1, 4, 10, 20, 35, &c.; and so on as below:

Order.	*Names.*	*Numbers.*					
1.	Equals.	1,	1,	1,	1,	1,	&c.
2.	Arithmeticals,	1,	2,	3,	4,	5,	&c.
3.	Triangulars,	1,	3,	6,	10,	15,	&c.
4.	Pyramidals,	1,	4,	10,	20,	35,	&c.
5.	2d Pyramidals,	1,	5,	15,	35,	70,	&c.
6.	3d Pyramidals,	1,	6,	21,	56,	126,	&c.
7.	4th Pyramidals,	1,	7,	28,	84,	210,	&c.

The above are all considered as different sorts of triangular numbers, being formed from an arithmetical progression whose common difference is 1. But if that common difference be 2, the successive sums will be the series of square numbers: if it be 3, the series will be pentagonal numbers, or pentagons; if it be 4, the series will be hexagonal numbers, or hexagons; and so on. Thus:

Arithmeticals.

Arithmeticals.	1st *Sums*, or *Polygons*.					2d *Sums*, or 2d *Polygons*.
1, 2, 3, 4,	Tri.	1,	3,	6,	10	1, 4, 10, 20
1, 3, 5, 7,	Sqrs.	1,	4,	9,	16	1, 5, 14, 30
1, 4, 7, 10,	Pent.	1,	5,	12,	22	1, 6, 18, 40
1, 5, 9, 13, &c.	Hex.	1,	6,	15,	28	1, 7, 22, 50

And the reaſon of the names triangles, ſquares, pentagons, hexagons, &c. is, that thoſe numbers may be placed in the form of theſe regular figures or polygons.

But the figurate numbers of any order may alſo be found without computing thoſe of the preceding orders; which is done by taking the ſucceſſive products of as many of the terms of the arithmeticals, 1, 2, 3, 4, 5, &c. in their natural order, as there are units in the number which denominates the order of figurates required, and dividing thoſe products always by the firſt product: thus, the triangular numbers are found by dividing the products 1×2, 2×3, 3×4, 4×5, &c. each by the 1ſt pr. 1×2; the firſt pyramids by dividing the products $1\times2\times3$, $2\times3\times4$, $3\times4\times5$, &c. by the firſt $1\times2\times3$. And, in general, the figurate numbers of any order n, are found by ſubſtituting ſucceſſively 1, 2, 3, 4, 5, &c. inſtead of x in this general expreſſion $\frac{x\,.\,\overline{x+1}\,.\,\overline{x+2}\,.\,\overline{x+3}\,.\,\&c.}{1\,.\,2\,.\,3\,.\,4\,.\,\&c.}$; where the factors in the numerator and denominator are ſuppoſed to be multiplied together, and to be continued till the number in each be leſs by 1 than that which expreſſes the order of the figurates required. See Maclaurin's Fluxions, art. 351, in the notes; alſo Simpſon's Algebra, p. 213; or Malcolm's Arithmetic, p. 396, where the ſubject of figurates is treated in a very extenſive and perſpicuous manner. *Hutton's Mathematical Dictionary.*

Polygonal or polygonous numbers, the ſums of arithmetical progreſſions beginning with unity: theſe, where the common difference is 1, are called *triangular numbers;* where 2, *ſquare numbers;* where 3, *pentagonal numbers;* where 4, *hexagonal numbers;* where 5, *heptagonal numbers*, &c.

Pyramidal numbers, the ſums of polygonous numbers, collected after the ſame manner as the polygons themſelves, and not gathered out of arithmetical progreſſions, are called *firſt pyramidal numbers;* the ſums of the firſt pyramidals are called *ſecond pyramidals*, &c.

If they ariſe out of triangular numbers, they are called *triangular pyramidal numbers;* if out of pentagons, *firſt pentagonal pyramidals.*

From the manner of ſumming up polygonal numbers, it is eaſy to conceive how the prime pyramidal numbers are found, viz. $\frac{(a-2)n^3+3n^3-(a-5)n}{6}$ expreſſes all the prime pyramidals.

The number nine has a very curious property, its products always compoſing either 9 or ſome leſſer product of it. We have already given an account of this, with the examples from Hume, under the article NINE; and we need not repeat them. Did our limits permit us, we could inſtance in a variety of other properties numbers both curious and ſurpriſing. Such ſpeculations are indeed by ſome men conſidered as trifling and uſeleſs: but perhaps they judge too haſtily; for few employments are more innocent, none more ingenious, nor, to thoſe who have a taſte for them, more amuſing.

Numbers were by the Jews, as well as the ancient Greeks and Romans, expreſſed by letters of the alphabet: hence we may conceive how imperfect and limited their arithmetic was, becauſe the letters could not be arranged in a ſeries, or in different lines, conveniently enough for the purpoſes of ready calculation. The invention of the cypher, or arithmetical figures, which we now make uſe of, has given us a very great advantage over the ancients in this reſpect.

Mankind, we may reaſonably ſuppoſe, firſt reckoned by their fingers, which they might indeed do in a variety of ways. From this digital arithmetic, very probably, is owing the number 10, which conſtitutes the whole ſet of arithmetical figures.

The letters chiefly employed by the Romans to expreſs numbers were, M, for, 1000; D, for 500; C, for 100; L, for 50; V, for five; X, for 10; and I, for one.—M, probably ſignified 1000, becauſe it is the initial of *mille;* D ſtands for 500, becauſe it is *dimidium mille;* C ſignifies 100, as being the firſt letter of the word *centum;* L ſtands for 50, becauſe it is the half of C, having formerly been wrote thus ᒪ; V ſignifies 5, becauſe V is the fifth vowel; X ſtands for 10, becauſe it contains twice $\overset{\text{V}}{\text{Λ}}$ or V in a double form; I ſtands for one, becauſe it is the firſt letter of *initium.* Theſe however are fanciful derivations. See NUMERAL *Letters.*

The Jewiſh cabbaliſts, the Grecian conjurors, and the Roman augurs, had a great veneration for particular numbers, and the reſult of particular combinations of them. Thus three, four, ſix, ſeven, nine, ten, are full of divine myſteries, and of great efficacy.

Golden NUMBER. See CHRONOLOGY, N° 27.

NUMBERS, in *Poetry*, *Oratory*, *&c.* are certain meaſures, proportions, or cadences, which render a verſe, period, or ſong, agreeable to the ear.

Poetical numbers conſiſt in a certain harmony in the order, quantities, &c. of the feet and ſyllables, which make the piece muſical to the ear, and fit for ſinging, for which all the verſes of the ancients were intended. See POETRY.—It is of theſe numbers Virgil ſpeaks in his ninth Eclogue, when he makes Lycidas ſay, *Numeros memini, ſi verba tenerem;* meaning, that although he had forgot the words of the verſes, yet he remembered the feet and meaſure of which they were compoſed.

Rhetorical or proſaic numbers are a ſort of ſimple unaffected harmony, leſs glaring than that of verſe, but ſuch as is perceived and affects the mind with pleaſure.

The numbers are that by which the ſtyle is ſaid to be eaſy, free, round, flowing, &c. Numbers are things abſolutely neceſſary in all writing, and even in all ſpeech. Hence Ariſtotle, Tully, Quintilian, &c. lay down abundance of rules as to the beſt manner of intermixing dactyles, ſpondees, anapeſts, &c. in order to have the numbers perfect. The ſubſtance of what they have ſaid, is reducible to what follows: 1. The ſtyle becomes numerous by the alternate diſpoſition and temperature of long and ſhort ſyllables, ſo as that the multitude of ſhort ones neither render it too haſty, nor that of long ones too

too ſlow and languid: ſometimes, indeed, long and ſhort ſyllables are thrown together deſignedly without any ſuch mixture, to paint the ſlowneſs or celerity of any thing by that of the numbers; as in theſe verſes of Virgil:

Illi inter ſeſe magna vi brachia tollunt;

and

Radit iter liquidum, celeres neque commovet alas.

2. The ſtyle becomes numerous, by the intermixing words of one, two, or more ſyllables; whereas the too frequent repetition of monoſyllables renders the ſtyle pitiful and grating. 3. It contributes greatly to the numerouſneſs of a period, to have it cloſed by magnificent and well-ſounding words. 4. The numbers depend not only on the nobleneſs of the words in the cloſe, but of thoſe in the whole tenor of the period. 5. To have the period flow eaſily and equally, the harſh concurrence of letters and words is to be ſtudiouſly avoided, particularly the frequent meeting of rough conſonants; the beginning the firſt ſyllable of a word with the laſt of the preceding; the frequent repetition of the ſame letter or ſyllable; and the frequent uſe of the like ending words. Laſtly, The utmoſt care is to be taken, leſt, in aiming at oratorial numbers, you ſhould fall into poetical ones; and inſtead of proſe, write verſe.

Book of NUMBERS, the fourth book of the Pentateuch, taking its denomination from its numbering the families of Iſrael.

A great part of this book is hiſtorical, relating to ſeveral remarkable paſſages in the Iſraelites march through the wilderneſs. It contains a diſtinct relation of their ſeveral movements from one place to another, or their 42 ſtages through the wilderneſs, and many other things, whereby we are inſtructed and confirmed in ſome of the weightieſt truths that have immediate reference to God and his providence in the world.—But the greateſt part of this book is ſpent in enumerating thoſe laws and ordinances, whether civil or ceremonial, which were given by God, but not mentioned before in the preceding books.

NUMERAL LETTERS, thoſe letters of the alphabet which are generally uſed for figures; as I, one; V, five; X, ten; L, fifty; C, a hundred; D, five hundred; M, a thouſand, &c.

It is not agreed how the Roman numerals originally received their value. It has been ſuppoſed, as we have obſerved in the end of the article NUMBER, that the Romans uſed M to denote 1000, becauſe it is the firſt letter of *mille*, which is Latin for 1000; and C to denote 100, becauſe it is the firſt letter of *centum*, which is Latin for 100. It has alſo been ſuppoſed, that D, being formed by dividing the old M in the middle, was therefore appointed to ſtand for 500, that is, half as much as the M ſtood for when it was whole; and that L being half a C, was, for the ſame reaſon, uſed to denominate 50. But what reaſon is there to ſuppoſe, that 1000 and 100 were the numbers which letters were firſt uſed to expreſs? And what reaſon can be aſſigned why D, the firſt letter in the Latin word *decem*, ten, ſhould not rather have been choſen to ſtand for that number, than for 500, becauſe it had a rude reſemblance to half an M?—But if theſe queſtions could be ſatiſfactorily anſwered, there are other numeral letters which have never yet been accounted for at all. Theſe conſiderations render it probable that the Romans, did not, in their original intention, uſe letters to expreſs numbers at all; the moſt natural account of the matter ſeems to be this:

The Romans probably put down a ſingle ſtroke, I, for one, as is ſtill the practice of thoſe who ſcore on a ſlate or with chalk: this ſtroke, I, they doubled, trebled, and quadrupled, to expreſs 2, 3, and 4: thus, II. III. IIII. So far they could eaſily number the ſtrokes with a glance of the eye. But they preſently found, that if more were added, it would ſoon be neceſſary to tell the ſtrokes one by one: for this reaſon, then, when they came to 5, they expreſſed it by joining two ſtrokes together in an acute angle thus, V; which will appear the more probable, if it be conſidered that the progreſſion of the Roman numbers is from 5 to 5, i. e. from the fingers on one hand to the fingers on the other.—Ovid has touched upon the original of this in his *Faſtorum*, lib. iii. and *Vitruvius* has made the ſame remark.

After they had made this acute angle V. for five, they added the ſingle ſtrokes to it to the number of 4, thus, VI. VII. VIII. VIIII. and then as the ſtrokes could not be further multiplied without confuſion, they doubled their acute angle by prolonging the two lines beyond their interſection thus, X, to denote two fives, or ten. After this they doubled, trebled, and quadrupled, this double acute angle thus, XX. XXX. XXXX. they then, for the ſame reaſon which induced them firſt to make a ſingle and then to double it, joined two ſingle ſtrokes in another form, and inſtead of an acute angle, made a right angle L, to denote fifty. When this 50 was doubled, they then doubled the right angle thus ⊏, to denote 100, and having numbered this double right angle four times, thus ⊏⊏ ⊏⊏⊏ ⊏⊏⊏⊏; when they came to the fifth number, as before, they reverted it, and put a ſingle ſtroke before it thus I⊐, to denote 500; and when this 500 was doubled, then they alſo doubled their double right angle, ſetting two double right angles oppoſite to each other, with a ſingle ſtroke between them, thus ⊏I⊐ to denote 1000: when this note for 1000 had been four times repeated, then they put down I⊐⊐ for 5000, ⊏⊏I⊐⊐ for 10,000, and I⊐⊐⊐ for 50,000, and ⊏⊏⊏I⊐⊐⊐ for 100,000, I⊐⊐⊐⊐ for 500,000 and ⊏⊏⊏⊏I⊐⊐⊐⊐ for one million.

That the Romans did not originally write M for 1000, and C for 100, but ſquare characters, as they are written above, we are expreſsly informed by Paulus Manutius; but the corners of the angles being cut off by the tranſcribers for deſpatch, theſe figures were gradually brought into what are now numeral letters.—When the corners of ⊏I⊐ were made round, it ſtood thus CIↃ, which is ſo near the Gothic *m*, that it ſoon deviated into that letter; ſo I⊐ having the corner made round, it ſtood thus IↃ, and then eaſily deviated into D. ⊏ alſo became a plain C by the ſame means; the ſingle rectangle which denoted 50, was, without alteration, a capital L; the double acute angle was an X; the ſingle acute angle a V conſonant; and a plain ſingle ſtroke, the letter I; and thus theſe ſeven letters, M, D, C, L, X, V, I, became numerals.

NUMERAL Characters of the Arabs, are thoſe figures which are now uſed in all the operations of arithmetic in every nation of Europe. We have elſewhere ſhown that the Arabs derived the uſe of them moſt probably from

Numeral || Numerical.

from India, (See ARITHMETIC, N° 5.) This opinion, however, though very generally received, has been controverted with ſome ingenuity. A writer in the Gentleman's Magazine, at a period when that miſcellany was in its higheſt reputation, thus endeavours to prove that the Arabs derived their notations from the Greeks. "I maintain (ſays he) that the Indians received their numeral characters from the Arabians, and the Arabians from the Greeks, as from them they derived all their learning, which in ſome things they improved, but for the moſt part have altered. The numerical figures which they received from the Greeks are proofs of this alteration; which is ſo great, that without particular attention one can ſcarce diſcover in them the veſtiges of their origin. But when we compare them carefully and without prejudice, we find in them manifeſt traces of the Greek figures. The Greek numerical figures were no other than the letters of their alphabet. A ſmall ſtroke was the mark of unity. The B, being abridged of its two extremities, produced the 2. If you incline the γ a little on its left ſide, and cut off its foot, and make the left horn round towards the left ſide, you will produce a 3; the Δ makes the 4, by raiſing the right leg perpendicularly, and lengthening it a little below the baſe, and lengthening the baſe on the left ſide. The ε forms the 5, by turning the loweſt ſemicircle towards the right, which before was turned towards the left ſide. The number 5 forms the 6 by having its head taken off, and its body rounded. Z, by taking away the baſe, makes the 7. If we make the top and bottom of H round, we ſhall form an 8. The θ is the 9 with very little alteration. The cypher o was only a point, to which one of the figures was added to make it ſtand for ten times as much. It was neceſſary to mark this point very ſtrongly; and in order to form it better, a circle was made, which was filled up in the middle; but that circumſtance was afterwards neglected. Theophanes, an hiſtorian of Conſtantinople, who lived in the ninth century, ſays expreſsly, that the Arabians retained the Greek figures, having no characters in their language to repreſent all the numbers. The Greeks obſerved in their numbers the decuple progreſſion, which the Arabians have retained. Certain characters are found in the Greek alphabet, which are not uſed in reading, but only in calculation, and for this reaſon they are ſtyled *Epiſemes*, that is to ſay, *notes*, *marks*, in order to diſtinguiſh them from letters. The number 6 derives its form from one of theſe epiſemes, which was called επισημον βαυ. This epiſeme forms the letter F among the Æolians and among the Latins. This was called the *Digamma*, ſo ſtyled from its figure, which ſeems to have been one Γ placed upon another.

That this reaſoning is plauſible will hardly be queſtioned; but whether it be concluſive our readers muſt determine. It has not convinced ourſelves; but through the whole of this work we wiſh to ſtate candidly the different opinions held on every ſubject of curioſity and uſefulneſs.

NUMERATION, or NOTATION, in *Arithmetic*, the art of expreſſing in characters any number propoſed in words, or of expreſſing in words any number propoſed in characters. See ARITHMETIC, N° 7.

NUMERICAL, NUMEROUS, or *Numeral*, ſomething belonging to numbers; as numerical algebra is that which makes uſe of numbers, inſtead of letters of the alphabet.—Alſo numerical difference is that by which one man is diſtinguiſhed from another. Hence a thing is ſaid to be numerically the ſame, when it is ſo in the ſtricteſt ſenſe of the word.

Numida, Numidia.

NUMIDA, a genus of birds belonging to the order of gallinæ. See ORNITHOLOGY *Index*.

NUMIDIA, an ancient kingdom of Africa, bounded on the north by the Mediterranean ſea; on the ſouth by Gætulia, or part of Libya Interior; on the weſt by the Mulucha, a river which ſeparated it from Mauritania; and on the eaſt by the Tuſca, another river which bounded it in common with Africa Propria. Dr Shaw has rendered it probable, that the river which formerly went under the denominations of *Malva*, *Malvana*, *Mulucha*, and *Molochath*, is the ſame with that now called MULLOOIAH by the Algerines; in which caſe, the kingdom of Numidia muſt have extended upwards of 500 miles in length: its breadth, however, cannot be ſo well aſcertained; but ſuppoſing it to have been the ſame with that of the preſent kingdom of Algiers, in the narroweſt part it muſt have been at leaſt 40 miles broad, and in the wideſt upwards of 100.

1 Ancient diviſion.

This country included two diſtricts; one inhabited by the *Maſſyli*, and the other by the *Maſſæſyli*; the latter being alſo called in after times, *Mauritania Cæſarienſis*, and the former *Numidia Propria*. The country of the Maſſyli, or, as ſome call it, *Terra Metagonitis*, was ſeparated from the proper territory of Carthage by its eaſtern boundary the river Tuſca, and from the kingdom of the Maſſæſyli, or Mauritania Cæſarienſis, by the river Ampſaga. It ſeems to correſpond with that part of the province of Conſtantina lying between the Zaine and the Wed al Kibeer, which is above 130 miles long, and more than 100 broad. The ſea coaſt of this province is for the moſt part mountainous and rocky, anſwering to the appellation given to it by Abulfeda, viz. *El Edwaa*, *the high or lofty*. It is far from being equal in extent to the ancient country of the Maſſæſyli, which, Strabo informs us, was yet inferior to the country of the Maſſyli. Its capital was Cirta, a place of very conſiderable note among the ancients.

2 Peopled by the deſcendants of Phut.

The moſt celebrated antiquarians agree, that the tract, extending from the iſthmus of Suez to the lake Tritonis, was chiefly peopled by the deſcendants of Mizraim, and that the poſterity of his brother Put, or Phut, ſpread themſelves all over the country between that lake and the Atlantic ocean. To this notion Herodotus gives great countenance: for he tells us, that the Libyan Nomades, whoſe territories to the weſt were bounded by the Triton, agreed in their cuſtoms and manners with the Egyptians; but that the Africans, from that river to the Atlantic ocean, differed in almoſt all points from them. Ptolemy mentions a city called *Putea* near Adrametum; and Pliny, a river of Mauritania Tingitana, known by the name of *Fut*, or *Phut*; and the diſtrict adjacent to this river was called *Regio Phutenſis*, which plainly alludes to the name of *Phut*. That word ſignifies *ſcattered*, or *diſperſed*, which very well agrees with what Mela and Strabo relate of the ancient Numidians; ſo that we may, without any ſcruple, admit the aborigines of this country to have been the deſcendants of Phut.

3 Great part of the hiſtory unknown.

The hiſtory of Numidia, during many of the early ages, is buried in oblivion. It is probable, however, that as the Phœnicians were maſters of a great part of the

Numidia. the country, these transactions had been recorded, and generally known to the Carthaginians. King Jarbas probably reigned here as well as in Africa Propria, if not in Mauritania, and other parts of Libya, when Dido began to build Byrsa. It appears from Justin, that about the age of Herodotus, the people of this country were called both *Africans* or *Libyans* and *Numidians*. Justin likewise intimates, that about this time the Carthaginians vanquished both the Moors or Mauritanians and the Numidians; in consequence of which they were excused from paying the tribute which had hitherto been demanded of them.

After the conclusion of the first Punic war, the African troops carried on a bloody contest against their masters the Carthaginians; and the most active in this rebellion, according to Diodorus Siculus, were a part of the Numidian nation named *Micatanians*. This so incensed the Carthaginians, that after Hamilcar had either killed or taken prisoners all the mercenaries, he sent a large detachment to ravage the country of those Numidians. The commandant of that detachment executed his orders with the utmost cruelty, plundering the district in a terrible manner, and crucifying all the prisoners without distinction that fell into his hands. This filled the rest with such indignation and resentment, that both they and their posterity ever afterwards bore an implacable hatred to the Carthaginians.

4
History of Syphax and Masinissa.

In the time of the second Punic war, Syphax king of the Massæsyli entered into an alliance with the Romans, and gave the Carthaginians a considerable defeat. This induced Gala, king of the Massyli, to conclude a treaty with the Carthaginians, in consequence of which his son Masinissa marched at the head of a powerful army to give Syphax battle. The contest ended in favour of Masinissa; 30,000 of the Massæsyli were put to the sword, and Syphax driven into Mauritania; and the like bad success attended Syphax in another engagement, where his troops were entirely defeated and dispersed.

Gala dying whilst his son Masinissa was acting at the head of the Numidian troops sent to the assistance of the Carthaginians in Spain, his brother Desalces, according to the established rules of succession in Numidia, took possession of the Massylian throne. That prince dying soon after his succession, Capusa his eldest son succeeded him. But he did not long enjoy his high dignity; for one Mezetulus, a person of the royal blood, but an enemy to the family of Gala, found means to excite a great part of his subjects to revolt. A battle soon took place between him and Capusa; in which the latter was slain with many of the nobility, and his army entirely defeated. But though Mezetulus thus became possessed of the sovereignty, he did not think proper to assume the title of *king*, but styled himself guardian to Lacumaces, the surviving son of Desalces, whom he graced with the royal title. To support himself in his usurpation, he married the dowager of Desalces, who was Hannibal's niece, and consequently of the most powerful family in Carthage. In order to attain the same end, he sent ambassadors to Syphax, to conclude a treaty of alliance with him. In the mean time Masinissa, receiving advice of his uncle's death, of his cousin's slaughter, and of Mezetulus's usurpation, immediately passed over to Africa, and went to the court of Bocchar king of Mauritania to sollicit succours. Bocchar, sensible of the great injustice done Masinissa, gave him a body of 4000 Moors to escort him to his dominions. His subjects, having been apprised of his approach, joined him upon the frontiers with a party of 500 men. The Moors, in pursuance of their orders, returned home, as soon as Masinissa reached the confines of his kingdom. Notwithstanding which, and the small body that declared for him having accidentally met Lacumaces at Thapsus with an escort going to implore Syphax's assistance, he drove him into the town, which he carried by assault after a faint resistance. However, Lacumaces, with many of his men, found means to escape to Syphax. The fame of this exploit gained Masinissa great credit, insomuch that the Numidians flocked to him from all parts, and amongst the rest, many of his father Gala's veterans, who pressed him to make a speedy and vigorous push for his hereditary dominions. Lacumaces having joined Mezetulus with a reinforcement of Massæsylians, which he had prevailed upon Syphax to send to the assistance of his ally, the usurper advanced at the head of a numerous army to offer Masinissa battle; which that prince, though much inferior in numbers, did not decline. Hereupon an engagement ensued; which notwithstanding the inequality of numbers, ended in the defeat of Lacumaces. The immediate consequence of this victory of Masinissa was a quiet and peaceable possession of his kingdom; Mezetulus and Lacumaces, with a few that attended them, flying into the territories of Carthage. However, being apprehensive that he should be obliged to sustain a war against Syphax, he offered to treat Lacumaces with as many marks of distinction as his father Gala had Desalces, provided that prince would put himself under his protection. He also promised Mezetulus pardon, and a restitution of all the effects forfeited by his treasonable conduct, if he would make his submission to him. Both of them readily complied with the proposal, and immediately returned home; so that the tranquillity and repose of Numidia would have been settled upon a solid and lasting foundation, had not this been prevented by Asdrubal, who was then at Syphax's court. He insinuated to that prince, who was disposed to live amicably with his neighbours, "That he was greatly mistaken, if he imagined Masinissa would be satisfied with his hereditary dominions. That he was a prince of much greater capacity and ambition, than either his father Gala, his uncle Desalces, or any of his family. That he had discovered in Spain marks of a most rare and uncommon merit. And that, in fine, unless his rising flame was extinguished before it came to too great a head, both the Massæsylian and Carthaginian states would be infallibly consumed by it." Syphax, alarmed by these suggestions, advanced with a numerous body of forces into a district which had long been in dispute between him and Gala, but was then in possession of Masinissa. This brought on a general action between these two princes; wherein the latter was totally defeated, his army dispersed, and he himself obliged to fly to the top of Mount Balbus, attended only by a few of his horse. Such a decisive battle at the present juncture, before Masinissa was fixed in his throne, could not but put Syphax into possession of the kingdom of the Massyli. Masinissa in the mean time made nocturnal incursions from his post upon Mount Balbus, and plundered all the adjacent country, particularly that part of the Carthaginian territory contiguous to Numidia. This district he not only thoroughly pillaged, but likewise laid waste with fire and sword, carrying off from thence an

Numidia. an immenſe booty, which was bought by ſome merchants, who had put into one of the Carthaginian ports for that purpoſe. In fine, he did the Carthaginians more damage, not only by committing ſuch dreadful devaſtations, but by maſſacring and carrying into captivity vaſt numbers of their ſubjects on this occaſion, than they could have ſuſtained in a pitched battle, or one campaign of a regular war. Syphax, at the preſſing and reiterated inſtances of the Carthaginians, ſent Bocchar, one of his moſt active commanders, with a detachment of 4000 foot, and 2000 horſe, to reduce this peſtilent gang of robbers, promiſing him a great reward if he could bring Maſiniſſa either alive or dead. Bocchar, watching an opportunity, ſurpriſed the Maſſylians, as they were ſtraggling about the country without any order or diſcipline; ſo that he took many priſoners, diſperſed the reſt, and purſued Maſiniſſa himſelf, with a few of his men, to the top of the mountain where he had before taken poſt. Conſidering the expedition as ended, he not only ſent many head of cattle, and the other booty that had fallen into his hands, to Syphax, but likewiſe all the force, except 500 foot and 200 horſe. With this detachment he drove Maſiniſſa from the ſummit of the hill, and purſued him through ſeveral narrow paſſes and defiles, as far as the plains of Clupea. Here he ſo ſurrounded him, that all the Maſſylians, except four, were put to the ſword, and Maſiniſſa himſelf, after having received a dangerous wound, eſcaped with the utmoſt difficulty. As this was effected by croſſing a rapid river, in which attempt two of his four attendants periſhed in the ſight of the detachment that purſued him, it was rumoured all over Africa, that Maſiniſſa alſo was drowned; which gave inexpreſſible pleaſure to Syphax and the Carthaginians. For ſome time he lived undiſcovered in a cave, where he was ſupported by the robberies of the two horſemen that had made their eſcape with him. But having cured his wound by the application of ſome medicinal herbs, he boldly began to advance towards his own frontiers, giving out publicly that he intended once more to take poſſeſſion of his kingdom. In his march he was joined by about 40 horſe, and, ſoon after his arrival amongſt the Maſſyli, ſo many people flocked to him from all parts, that out of them he formed an army of 6000 foot and 4000 horſe. With theſe forces, he not only reinſtated himſelf in the poſſeſſion of his dominions, but likewiſe laid waſte the borders of the Maſſæſyli. This ſo irritated Syphax, that he immediately aſſembled a body of troops, and encamped very commodiouſly upon a ridge of mountains between Cirta and Hippo. His army he commanded in perſon; and detached his ſon Vermina, with a conſiderable force, to take a compaſs, and attack the enemy in the rear. In purſuance of his orders, Vermina ſet out in the beginning of the night, and took poſt in the place appointed him, without being diſcovered by the enemy. In the mean time Syphax decamped, and advanced towards the Maſſyli, in order to give them battle. When he had poſſeſſed himſelf of a riſing ground that led to their camp, and concluded that his ſon Vermina muſt have formed the ambuſcade behind them, he began the fight. Maſiniſſa being advantageouſly poſted, and his ſoldiers diſtinguiſhing themſelves in an extraordinary manner, the diſpute was long and bloody. But Vermina unexpectedly falling upon their rear, and by this means obliging them to divide their forces, which were ſcarce able before to oppoſe the main body under Syphax, they were ſoon thrown into confuſion, and forced to betake themſelves to a precipitate flight. All the avenues being blocked up, partly by Syphax and partly by his ſon, ſuch a dreadful ſlaughter was made of the unhappy Maſſyli, that only Maſiniſſa himſelf, with 60 horſe, eſcaped to the Leſſer Syrtis. Here he remained, betwixt the confines of the Carthaginians and Garamantes, till the arrival of Lælius and the Roman fleet on the coaſt of Africa. What happened immediately after this junction with the Romans, belongs to the article ROME.

It will be ſufficient therefore in this place to obſerve, that, by the aſſiſtance of Lælius, Maſiniſſa at laſt reduced Syphax's kingdom. According to Zonaras, Maſiniſſa and Scipio, before the memorable battle of Zama, by a ſtratagem deprived Hannibal of ſome advantageous poſts; which, with a ſolar eclipſe happening during the heat of the action, and not a little intimidating the Carthaginian troops, greatly contributed to the victory the Romans obtained. At the concluſion therefore of the ſecond Punic war, he was amply rewarded by the Romans for the important ſervices he had done them. As for Syphax, after the loſs of his dominions, he was kept in confinement for ſome time at Alba; from whence being removed in order to grace Scipio's triumph, he died at Tibur in his way to Rome. Zonaras adds, that his corpſe was decently interred; that all the Numidian priſoners were releaſed; and that Vermina, by the aſſiſtance of the Romans, took peaceable poſſeſſion of his father's throne. However, part of the Maſſæſylian kingdom had been before annexed to Maſiniſſa's dominions, in order to reward that prince for his ſingular fidelity and cloſe attachment to the Romans.

This ſeems to be countenanced by the epitomizer of Livy, who gives us ſufficiently to underſtand, that Syphax's family, for a conſiderable time after the concluſion of the ſecond Punic war, reigned in one part of Numidia. For he intimates, that Archobarzanes, Syphax's grandſon, and probably Vermina's ſon, hovered with a powerful army of Numidians upon the Carthaginian frontiers a few years before the beginning of the third Punic war. This he ſeems to have done, either in order to cover them, or to enable the Carthaginians to make an irruption into Maſiniſſa's territories. Cato, however, pretended that theſe forces, in conjunction with thoſe of Carthage, had a deſign to invade the Roman dominions, which he urged as a reaſon to induce the conſcript fathers to deſtroy the African republic.

Nothing is further requiſite, in order to complete the hiſtory of this famous prince, than to exhibit to our readers view ſome points of his conduct towards the decline, and at the cloſe, of life; the wiſe diſpoſitions made after his death by Æmilianus, in order to the regulation of his domeſtic affairs; and ſome particulars relating to his character, genius, and habit of body, drawn from the moſt celebrated Greek and Roman authors.

By drawing a line of circumvallation around the Carthaginian army under Aſdrubal, poſted upon an eminence, Maſiniſſa cut off all manner of ſupplies from them; which introduced both the plague and famine into their camp. As the body of Numidian troops em-

 ployed

Numidia. ployed in this blockade was not near ſo numerous as the Carthaginian forces, it is evident, that the line here mentioned muſt have been extremely ſtrong, and conſequently the effect of great labour and art. The Carthaginians, finding themſelves reduced to the laſt extremity, concluded a peace upon the following terms, which Maſiniſſa dictated to them: 1. That they ſhould deliver up all deſerters. 2. That they ſhould recal their exiles, who had taken refuge in his dominions. 3. That they ſhould pay him 5000 talents of ſilver within the ſpace of 50 years. 4. That their ſoldiers ſhould paſs under the jugum, each of them carrying off only a ſingle garment. As Maſiniſſa himſelf, though between 80 and 90 years of age, conducted the whole enterpriſe, he muſt have been extremely well verſed in fortification, and other branches of the military art. His underſtanding likewiſe he muſt have retained to the laſt. This happened a ſhort time before the beginning of the third Punic war. See Carthage.

5 Maſiniſſa diſpleaſed with the Romans;

Soon after, the conſuls landed an army in Africa, in order to lay ſiege to Carthage, without imparting to Maſiniſſa their deſign. This not a little chagrined him, as it was contrary to the former practice of the Romans; who, in the preceding war, had communicated their intentions to him, and conſulted him on all occaſions. When, therefore, the conſuls applied to him for a body of his troops to act in concert with their forces, he made anſwer, "That they ſhould have a reinforcement from him when they ſtood in need of it." It could not but be provoking to him to conſider, that after he had extremely weakened the Carthaginians, and even brought them to the brink of ruin, his pretended imperious friends ſhould come to reap the fruits of his victory, without giving him the leaſt intelligence of it.

However, his mind ſoon returned to its natural bias, which was in favour of the Romans. Finding his end approaching, he ſent to Æmilianus, then a tribune in the Roman army, to deſire a viſit from him. What he propoſed by this viſit, was to inveſt him with full powers to diſpoſe of his kingdom and eſtate as he ſhould think proper, for the benefit of his children. The high idea he had entertained of that young hero's abilities and integrity, together with his gratitude and affection for the family into which he was adopted, induced him to take this ſtep. But, believing that death would not permit him to have a perſonal conference with Æmilianus upon this ſubject, he informed his wife and children in his laſt moments, that he had empowered him to diſpoſe in an abſolute manner of all his poſſeſſions, and divide his kingdom amongſt his ſons. To which he ſubjoined, "I require, that whatever Æmilianus may decree, ſhall be executed as punctually as if I myſelf had appointed it by my will." Having uttered theſe words, he expired, at about 90 years of age.

6 but leaves every thing to the diſpoſal of Æmilianus.

This prince, during his youth, had met with ſtrange reverſes of fortune. However, ſays Appian, being ſupported by the Divine protection, he enjoyed an uninterrupted courſe of proſperity for a long ſeries of years. His kingdom extended from Mauritania to the weſtern confines of Cyrenaica; from whence it appears, that he was one of the moſt powerful princes of Africa. Many of the inhabitants of this vaſt tract he civilized in a wonderful manner, teaching them to cultivate their ſoil, and to reap thoſe natural advantages which the fertility of ſome parts of their country offered them. He was of a more robuſt habit of body than any of his cotemporaries, being bleſſed with the greateſt health and vigour; which was doubtleſs owing to his extreme temperance, and the toils he inceſſantly ſuſtained. We are informed by Polybius, that ſometimes he ſtood upon the ſame ſpot of ground from morning till evening, without the leaſt motion, and at others continued as long in a ſitting poſture. He would remain on horſeback for ſeveral days and nights together, without being ſenſible of the leaſt fatigue. Nothing can better evince the ſtrength of his conſtitution, than his youngeſt ſon, named *Stembal*, *Sthemba*, or *Stembanus*, who was but four years old at his deceaſe. Though 90 years of age, he performed all the exerciſes uſed by young men, and always rode without a ſaddle. Pliny tells us, that he reigned above 60 years. He was an able commander, and much facilitated the reduction of Carthage. Plutarch from Polybius obſerves, that the day after a great victory won over the Carthaginians, Maſiniſſa was ſeen ſitting at the door of his tent, eating a piece of brown bread. Suidas relates, that to the laſt he could mount his horſe without any aſſiſtance. According to Appian he left a numerous well diciplined army, and an immenſe quantity of wealth, behind him.

Maſiniſſa, before his death, gave his ring to his eldeſt ſon Micipſa; but left the diſtribution of all his other effects and poſſeſſions amongſt his children entirely to Æmilianus. Of 54 ſons that ſurvived him, only three were legitimate, to wit, Micipſa, Guluſſa, and Maſtanabal. Æmilianus, arrived at Cirta after he had expired, divided his kingdom, or rather the government of it, amongſt theſe three, though to the others he gave conſiderable poſſeſſions. To Micipſa, who was a prince of a pacific diſpoſition, and the eldeſt ſon, he aſſigned Cirta, the metropolis, for the place of his reſidence, in excluſion of the others. Guluſſa, the next to him, being a prince of military genius, had the command of the army, and the tranſacting of all affairs relating to peace or war committed to his care. And Manaſtabal, the youngeſt, had the adminiſtration of juſtice, an employment ſuitable to his education, allotted him. They enjoyed in common the immenſe treaſures Maſiniſſa had amaſſed, and were all of them dignified by Æmilianus with the royal title. After he had made theſe wiſe diſpoſitions, that young nobleman departed from Cirta, taking with him a body of Numidian troops, under the conduct of Guluſſa, to reinforce the Roman army that was then acting againſt the Carthaginians.

Maſtanabal and Guluſſa died ſoon after their father, as appears from the expreſs teſtimony of Salluſt. We find nothing more remarkable of theſe princes, beſides what has been already related, than that the latter continued to aſſiſt the Romans in the third Punic war, and that the former was pretty well verſed in the Greek language. Micipſa therefore became ſole poſſeſſor of the kingdom of Numidia. In his reign, and under the conſulate of M. Platius Hypſæus and M. Fulvius Flaccus, according to Oroſius, a great part of Africa was covered with locuſts, which deſtroyed all the produce of the earth, and even devoured dry wood. But at laſt they were all carried by the wind into the African ſea, out of which being thrown in vaſt heaps upon the ſhore, a plague enſued which ſwept away an infinite number

Numidia. number of animals of all kinds. In Numidia only 800,000 men perished, and in Africa Propria 200,000; amongst the rest, 30,000 Roman soldiers quartered in and about Utica for the defence of the latter province. At Utica, in particular, the mortality raged to such a degree, that 1500 dead bodies were carried out of one gate in a day. Micipsa had two sons, Adherbal and Hiempsal, whom he educated in his palace, together with his nephew Jugurtha. That young prince was the son of Mastanabal; but his mother having been only a concubine, Masinissa had taken no great notice of him. However, Micipsa considering him as a prince of the blood, took as much care of him as he did of his own children.

7 History of Jugurtha.

Jugurtha possessed several eminent qualities, which gained him universal esteem. He was very handsome, endued with great strength of body, and adorned with the finest intellectual endowments. He did not devote himself, as young men commonly do, to a life of luxury and pleasure. He used to exercise himself, with persons of his age, in running, riding, hurling the javelin, and other manly exercises, suited to the martial genius of the Numidians; and though he surpassed all his fellow sportsmen, there was not one of them but loved him. The chase was his only delight; but it was that of lions and other savage beasts. Sallust, to finish his character, tells us, that he excelled in all things, and spoke very little of himself.

So conspicuous an assemblage of fine talents and perfections, at first charmed Micipsa, who thought them an ornament to his kingdom. However, he soon began to reflect, that he was considerably advanced in years, and his children in their infancy; that mankind naturally thirsted after power, and that nothing was capable of making men run greater lengths than a vicious and unlimited ambition. These reflections soon excited his jealousy, and determined him to expose Jugurtha to a variety of dangers, some of which, he entertained hopes, might prove fatal to him. In order to this, he gave him the command of a body of forces which he sent to assist the Romans, who were at that time besieging Numantia in Spain. But Jugurtha, by his admirable conduct, not only escaped all those dangers, but likewise won the esteem of the whole army, and the friendship of Scipio, who sent a high character of him to his uncle Micipsa. However, that general gave him some prudent advice in relation to his future conduct; observing, no doubt, in him certain sparks of ambition, which, if lighted into a flame, he apprehended might one day be productive of the most fatal consequences.

8 Is dreaded by King Micipsa,

Before this last expedition, Micipsa had endeavoured to find out some method of taking him off privately; but his popularity amongst the Numidians obliged that prince to lay aside all thoughts of this nature. After his return from Spain the whole nation almost adored him. The heroic bravery he had shown there, his undaunted courage, joined to the utmost calmness of mind, which enabled him to preserve a just medium between a timorous foresight and an impetuous rashness, a circumstance rarely to be met with in persons of his age, and above all the advantageous testimonials of his conduct given by Scipio, attracted an universal esteem. Nay, Micipsa himself, charmed with the high opinion the Roman general had entertained of his merit, changed his behaviour towards him; resolving, if possible, to win his affection by kindness. He therefore adopted him, and declared him joint heir with his two sons to the crown. Finding, some few years afterwards, that his end approached, he sent for all three to his bed side; where, in the presence of the whole court, he desired Jugurtha to recollect with what extreme tenderness he had treated him, and consequently to consider how well he had deserved at his hands. He then entreated him to protect his children on all occasions; who, being before related to him by the ties of blood, were now by their father's bounty become his brethren. In order to fix him the more firmly in their interest, he likewise complimented him upon his bravery, address, and consummate prudence. He further insinuated, that neither arms nor treasures constitute the strength of a kingdom; but friends, who are neither won by arms nor gold, but by real services and an inviolable fidelity. "Now, where (continued he) can we find better friends than in brothers? And how can that man who becomes an enemy to his relations, repose any confidence in, or depend upon strangers?" Then addressing himself to Adherbal and Hiempsal, "And you (said he) I enjoin always to pay the highest reverence to Jugurtha. Endeavour to imitate, and if possible surpass, his exalted merit, that the world may not hereafter observe Micipsa's adopted son to have reflected greater glory upon his memory than his own children." Soon after, Micipsa, who, according to Diodorus, was a prince of an amiable character, expired. Though Jugurtha did not believe the king to speak his real sentiments with regard to him, yet he seemed extremely pleased with so gracious a speech, and made him an answer suitable to the occasion. However, that prince at the same time was determined within himself to put in execution the scheme he had formed at the siege of Numantia, which was suggested to him by some factious and abandoned Roman officers, with whom he there contracted an acquaintance. The purport of this scheme was, that he should extort the crown by force from his two cousins, as soon as their father's eyes were closed; which they insinuated might easily be effected by his own valour, and the venality of the Romans. Accordingly, a short time after the old king's death, he found means to assassinate Hiempsal in the city of Thirmida where his treasures were deposited, and drive Adherbal out of his dominions. That unhappy prince found himself obliged to fly to Rome, where he endeavoured to engage the conscript fathers to espouse his quarrel; but, notwithstanding the justice of his cause, they had not virtue enough effectually to support him. Jugurtha's ambassadors, by distributing vast sums of money amongst the senators, brought them so far over, that a majority palliated his inhuman proceedings. This encouraged those ministers to declare, that Hiempsal had been killed by the Numidians on account of his excessive cruelty; that Adherbal was the aggressor in the late troubles; and that he was only chagrined because he could not make that havock among his countrymen he would willingly have done. They therefore entreated the senate to form a judgement of Jugurtha's behaviour in Africa from his conduct at Numantia, rather than from the suggestions of his enemies. Upon which, by far the greatest part of the senate discovered themselves prejudiced

Numidia.

9 who nevertheless entrusts him with the care of his children;

10 one of whom he murders, and drives out the other.

Numidia. prejudiced in his favour. A few, however, that were not lost to honour, nor abandoned to corruption, insisted upon bringing him to condign punishment. But as they could not prevail, he had the best part of Numidia allotted him, and Adherbal was forced to rest satisfied with the other.

11 Venality of the Romans.

Jugurtha finding now by experience that every thing was venal at Rome, as his friends at Numantia had before informed him, thought he might pursue his towering projects without any obstruction from that quarter. He therefore, immediately after the last division of Micipsa's dominions, threw off the mask, and attacked his cousin by open force. As Adherbal was a prince of a pacific disposition, and almost in all respects the reverse of Jugurtha, he was by no means a match for him. The latter therefore pillaged the former's territories, stormed several of his fortresses, and overran a good part of his kingdom without opposition. Adherbal, depending on the friendship of the Romans, which his father in his last moments assured him would be a stronger support to him than all the troops and treasures in the universe, despatched deputies to Rome to complain of these hostilities. But whilst he lost his time in sending thither fruitless deputations, Jugurtha overthrew him in a pitched battle, and soon after shut him up in Cirta. During the siege of this city, a Roman commission arrived there, in order to persuade both parties to an accommodation; but finding Jugurtha untractable, the commissioners returned home without so much as conferring with Adherbal. A second deputation, composed of senators of the highest distinction, with Æmilius Scaurus, president of the senate, at their head, landed some time after at Utica, and summoned Jugurtha to appear before them. That prince at first seemed to be under dreadful apprehensions, especially as Scaurus reproached him with his enormous crimes, and threatened him with the resentment of the Romans if he did not immediately raise the siege of Cirta. However, the Numidian, by his address, and the irresistible power of gold, as was afterwards suspected at Rome, so mollified Scaurus, that he left Adherbal at his mercy. In fine, Jugurtha had at last Cirta surrendered to him, upon condition only that he should spare the life of Adherbal. But the merciless tyrant, in violation of the laws of nature and humanity as well as the capitulation, when he had got possession of the town, ordered him to be put to a most cruel death. The merchants likewise, and all the Numidians in the place capable of bearing arms, he caused without distinction to be put to the sword.

Every person at Rome inspired with any sentiments of humanity, was struck with horror at the news of this tragical event. However, all the venal senators still concurred with Jugurtha's ministers in palliating his enormous crimes. Notwithstanding which, the people, excited thereto by Caius Memmius their tribune, who bitterly inveighed against the venality of the senate, resolved not to let so flagrant an instance of villany go unpunished. This disposition in them induced the conscript fathers likewise to declare their intention to chastise Jugurtha. In order to this, an army was levied to invade Numidia, and the command of it given to the consul Calpurnius Bestia, a person of good abilities, but rendered unfit for the expedition he was to go upon by his insatiable avarice. Jugurtha being informed of the great preparations making at Rome to attack his dominions, sent his son thither to avert the impending storm. The young prince was plentifully supplied with money, which he had orders to distribute liberally amongst the leading men. But Bestia, proposing to himself great advantages from an invasion of Numidia, defeated all his intrigues, and got a decree passed, ordering him and his attendants to depart Italy in ten days, unless they were come to deliver up the king himself, and all his territories, to the republic by way of dedition. Which decree being notified to them, they returned without so much as having entered the gates of Rome; and the consul soon after landed with a powerful army in Africa. For some time he carried on the war there very briskly, reduced several strong holds, and took many Numidians prisoners. But upon the arrival of Scaurus, a peace was granted Jugurtha upon advantageous terms. That prince coming from Vacca, the place of his residence, to the Roman camp, in order to confer with Bestia and Scaurus, and the preliminaries of the treaty being immediately after settled between them in private conferences, every body at Rome was convinced that the prince of the senate and the consul had to their avarice sacrificed the republic. The indignation therefore of the people in general displayed itself in the strongest manner. Memmius also fired them with his speeches. It was therefore resolved to despatch the prætor Cassius, a person they could confide in, to Numidia, to prevail upon Jugurtha to come to Rome, that they might learn from the king himself which of their generals and senators had been seduced by the pestilent influence of corruption. Upon his arrival there, he found means to bribe one Bæbius Salca, a man of great authority amongst the plebeians, but of insatiable avarice, by whose assistance he escaped with impunity. Nay, by the efficacy of gold, he not only eluded all the endeavours of the people of Rome to bring him to justice, but likewise enabled Bomilcar, one of his attendants, to get Massiva, an illegitimate son of Micipsa, assassinated in the streets of Rome. That young prince was advised by many Romans of probity, wellwishers to the family of Masinissa, to apply for the kingdom of Numidia; which coming to Jugurtha's ears, he prevented the application by this execrable step. However, he was obliged to leave Italy immediately.

Jugurtha had scarce set foot in Africa, when he received advice that the senate had annulled the shameful peace concluded with him by Bestia and Scaurus. Soon after, the consul Albinus transported a Roman army into Numidia, flattering himself with the hopes of reducing Jugurtha to reason before the expiration of his consulate. In this, however, he found himself deceived; for that crafty prince, by various artifices so amused and imposed upon Albinus, that nothing of moment happened that campaign. This rendered him strongly suspected of having betrayed his country, after the example of his predecessors. His brother Aulus, who succeeded him in the command of the army, was still more unsuccessful; for after rising from before Suthul, where the king's treasures were deposited, he marched his forces into a defile, out of which he found it impossible to extricate himself. He therefore was obliged to submit to the ignominious ceremony of passing under the *jugum*, with all his men, and to quit Numidia entirely in ten days time, Numidia. time, in order to deliver his troops from immediate destruction. The avaricious disposition of the Roman commander had prompted him to besiege Suthul, the possession of which place he imagined would make him master of all the wealth of Jugurtha, and consequently paved the way to such a scandalous treaty. However, this was declared void as soon as known at Rome, as being concluded without the authority of the people. The Roman troops retired into Africa Propria, which they had now reduced into the form of a Roman province, and there took up their winter quarters.

In the mean time Caius Mamillius Limetanus, tribune of the people, excited the plebeians to inquire into the conduct of those persons by whose assistance Jugurtha had found means to elude all the decrees of the senate. This put the body of the people into a great ferment; which occasioned a prosecution of the guilty senators, that was carried on, for some time, with the utmost heat and violence. Lucius Metellus the consul, during these transactions, had Numidia

12 Metellus sent against Jugurtha. assigned him for his province, and consequently was appointed general of the army destined to act against Jugurtha. As he perfectly disregarded wealth, the Numidian found him superior to all his temptations; which was a great mortification to him. To this he joined all the other virtues which constitute the great captain; so that Jugurtha found him in all respects inaccessible. That prince therefore was now forced to regulate his conduct according to the motions of Metellus, with the greatest caution; and to exert his utmost bravery, in order to compensate for that hitherto so favourable expedient which now began to fail him. Marius, Metellus's lieutenant, being likewise a person of uncommon merit, the Romans reduced Vacca, a large opulent city, and the most celebrated mart in Numidia. They also defeated Jugurtha in a pitched battle; overthrew Bomilcar, one of his generals, upon the banks of the Muthullus; and, in fine, forced the Numidian monarch to take shelter in a place rendered almost inaccessible by the rocks and woods with which it was covered. However, Jugurtha signalized himself in a surprising manner, exhibiting all that could be expected from the courage, abilities, and attention of a consummate general, to whom despair administers fresh strength, and suggests new lights. But his troops could not make head against the Romans; they were again worsted by Marius, though they obliged Metellus to raise the siege of Zama. Jugurtha therefore, finding his country everywhere ravaged, his most opulent cities plundered, his fortresses reduced, his towns burnt, vast numbers of his subjects put to the sword and taken prisoners, began to think seriously of coming to an accommodation with the Romans. His favourite

13 Who is betrayed by Bomilcar. Bomilcar, in whom he reposed the highest confidence, but who had been gained over to the enemy by Metellus, observing this disposition, found it no difficult matter to persuade him to deliver up his elephants, money, arms, horses, and deserters, in whom the main strength of his army consisted, into the hands of the Romans. Some of these last, in order to avoid the punishment due to their crime, retired to Bocchus king of Mauritania, and listed in his service. But Metellus ordering him to repair to Tisidium, a city of Numidia, there to receive farther directions, and he refusing a compliance with that order, hostilities were renewed with greater fury than ever. Fortune now seemed to declare in favour of Jugurtha: he retook Vacca, and massacred all the Roman garrison, except Turpilius the commandant. However, soon after, a Roman legion seized again upon it, and treated the inhabitants with the utmost severity. About this time, one of Mastanabal's sons, named *Gauda*, whom Micipsa in his will had appointed to succeed to the crown in case his two legitimate sons and Jugurtha died without issue, wrote to the senate in favour of Marius, who was then endeavouring to supplant Metellus. That prince having his understanding impaired by a declining state of health, fell a more easy prey to the base and infamous adulation of Marius. The Roman, soothing his vanity, assured him, that as he was the next heir to the crown, he might depend upon being fixed upon the Numidian throne, as soon as Jugurtha was either killed or taken; and that this must in a short time happen, when once he appeared at the head of the Roman army with an unlimited commission. Soon after, Bomilcar and Nabdalsa formed a design to assassinate Jugurtha, at the instigation of Metellus; but this being detected, Bomilcar and most of his accomplices suffered death. The plot however had such an effect upon Jugurtha, that he enjoyed afterwards no tranquillity or repose. He suspected persons of all denominations, Numidians as well as foreigners, of some black designs against him. Perpetual terrors sat brooding over his mind; insomuch that he never got a wink of sleep but by stealth, and often changed his bed in a low plebeian manner. Starting from his sleep, he would frequently snatch his sword, and break out into the most doleful cries: So strongly was he haunted by a spirit of fear, jealousy, and distraction! 14 A conspiracy against him.

Jugurtha having destroyed great numbers of his friends on suspicion of their having been concerned in the late conspiracy, and many more of them deserting to the Romans and Bocchus king of Mauritania, he found himself, in a manner, destitute of counsellors, generals, and all persons capable of assisting him in carrying on the war. This threw him into a deep melancholy, which rendered him dissatisfied with every thing, and made him fatigue his troops with a variety of contradictory motions. Sometimes he would advance with great celerity against the enemy, and at others retreat with no small swiftness from them. Then he resumed his former courage; but soon after despaired either of the valour or fidelity of the forces under his command. All his movements therefore proved unsuccessful, and at last he was forced by Metellus to a battle. That part of the Numidian army which Jugurtha commanded, behaved with some resolution; but the other fled at the first onset. The Romans therefore entirely defeated them, took all their standards, and made a few of them prisoners. But few of them were slain in the action; since, as Sallust observes, the Numidians trusted more to their heels than to their arms for safety in this engagement. 15 He is defeated by Metellus.

Metellus pursued Jugurtha and his fugitives to Thala. His march to this place being through vast deserts, was extremely tedious and difficult. But being supplied with leathern bottles and wooden vessels of all sizes taken from the huts of the Numidians, which were filled with water brought by the natives, who had submitted to him, he advanced towards that city, Numidia. city. He had no ſooner begun his march, than a moſt copious ſhower of rain, a thing very uncommon in thoſe deſerts, proved a great and ſeaſonable refreſhment to his troops. This ſo animated them, that upon their arrival before Thala, they attacked the town with ſuch vigour, that Jugurtha with his family, and treaſures depoſited therein, thought proper to abandon it. After a brave defence, it was reduced; the garriſon, conſiſting of Roman deſerters, ſetting fire to the king's palace, and conſuming themſelves, together with every thing valuable to them, in the flames. Jugurtha, being now reduced to great extremities, retired into Gætulia, where he formed a conſiderable corps. From thence he advanced to the confines of Mauritania; and engaged Bocchus king of that country, who had married his daughter, to enter into an alliance with him. In conſequence of which, having reinforced his Gætulian troops with a powerful body of Mauritanians, he turned the tables upon Metellus, and obliged him to keep cloſe within his entrenchments. Salluſt informs us, that Jugurtha bribed Bocchus's miniſters to influence that prince in his favour; and that having obtained an audience, he inſinuated, that, ſhould Numidia be ſubdued, Mauritania muſt be involved in its ruin, eſpecially as the Romans ſeemed to have vowed the deſtruction of all the thrones in the univerſe. In ſupport of what he advanced, he produced ſeveral inſtances very appoſite to the point in view. However, the ſame author ſeems to intimate, that Bocchus was determined to aſſiſt Jugurtha againſt his enemies by the ſlight the Romans had formerly ſhown him. That prince, at the firſt breaking out of the war, had ſent ambaſſadors to Rome, to propoſe an offenſive and defenſive alliance to the republic; which, though of the utmoſt conſequence to it at the juncture, a few of the moſt venal and infamous ſenators, who were abandoned to corruption, prevented from taking effect. This undoubtedly wrought more powerfully upon Bocchus in favour of Jugurtha, than the relation he ſtood in to him: For both the Moors and Numidians adapted the number of their wives to their circumſtances, ſo that ſome had 10, 20, &c. to their ſhare; their kings therefore were unlimited in this particular, and of courſe all degrees of affinity reſulting to them from marriage had little force. It is obſervable, that the poſterity of thoſe ancient nations have the ſame cuſtom prevailing amongſt them at this day.

16 Marius ſucceeds Metellus.

Such was the ſituation of affairs in Numidia, when Metellus received advice of the promotion of Marius to the conſulate. But, notwithſtanding this injurious treatment, he generouſly endeavoured to draw off Bocchus from Jugurtha, though this would facilitate the reduction of Numidia for his rival. To this end ambaſſadors were deſpatched to the Mauritanian court, who intimated to Bocchus, "That it would be highly imprudent to come to a rupture with the Romans without any cauſe at all; and that he had now a fine opportunity of concluding a moſt advantageous treaty with them, which was much preferable to a war. To which they added, that whatever dependence he might place upon his riches, he ought not to run the hazard of loſing his dominions by embroiling himſelf with other ſtates, when he could eaſily avoid this; that it was much eaſier to begin a war than to end it, which it was in the power of the victor alone to do; that, in fine, he would by no means conſult the intereſt of his ſubjects if he followed the deſperate fortunes of Jugurtha." To which Bocchus replied. "That for his part there was nothing he wiſhed for more than peace; but that he could not help pitying the deplorable condition of Jugurtha; that if the Romans, therefore, would grant that unfortunate prince the ſame terms they had offered him, he would bring about an accommodation." Metellus, let the Mauritanian monarch know, that it was not in his power to comply with what he deſired. However, he took care to keep up a private negotiation with him till the new conſul Marius's arrival. By this conduct he ſerved two wiſe ends. Firſt, He prevented Bocchus from coming to a general action with his troops; which was the very thing Jugurtha deſired, as hoping that this, whatever the event might be, would render a reconciliation betwixt him and the Romans impracticable. Secondly, This inaction enabled him to diſcover ſomething of the genius and diſpoſition of the Moors; a nation of whom the Romans, till then, had ſcarcely formed any idea; which, he imagined, might be of no ſmall ſervice, either to himſelf or his ſucceſſors, in the future proſecution of the war.

Jugurtha, being informed that Marius, with a numerous army, was landed at Utica, adviſed Bocchus to retire, with part of the troops, to ſome place of difficult acceſs, whilſt he himſelf took poſt upon another inacceſſible ſpot with the remaining corps. By this meaſure, he hoped the Romans would be obliged to divide their forces, and conſequently be more expoſed to his efforts and attacks. He likewiſe imagined, that ſeeing no formidable body appear, they would believe the enemy in no condition to make head againſt them; which might occaſion a relaxation of diſcipline, the uſual attendant of a too great ſecurity, and conſequently produce ſome good effect. However, he was diſappointed in both theſe views. For Marius, far from ſuffering a relaxation of diſcipline to take place, trained up his troops, which conſiſted chiefly of new levies, in ſo perfect a manner, that they were ſoon equal in goodneſs to any conſular army that ever appeared in the field. He alſo cut off great numbers of the Gætulian marauders, defeated many of Jugurtha's parties, and had like to have taken that prince himſelf near the city of Cirta. 17

He gains a great advantage over Jugurtha.

Theſe advantages, though not of any great importance, intimidated Bocchus, who now made overtures for an accommodation; but the Romans, not being ſufficiently ſatiſfied of his ſincerity, paid no great attention to them. In the mean time Marius puſhed on his conqueſts, reducing ſeveral places of leſs note, and at laſt reſolved to beſiege Capſa. That this enterpriſe might be conducted with the greater ſecrecy, he ſuffered not the leaſt hint of his deſign to tranſpire, even amongſt any of his officers. On the contrary, in order to blind them, he detached A. Manlius, one of his lieutenants, with ſome light-armed cohorts, to the city of Lares, where he had fixed his principal magazine, and depoſited the military cheſt. Before Manlius left the camp, that he might the more effectually amuſe him, he intimated, that himſelf with the army ſhould take the ſame route in a few days: but inſtead of that, he bent his march towards the Tanais, and in ſix days time arrived upon the banks of that river. Here he pitched his tents for a ſhort time, in order to refreſh his troops; which having done, he advanced to Capſa, and made himſelf maſter of it. As

Numidia. As the situation of this city rendered it extremely commodious to Jugurtha, whose plan of operations, ever since the commencement of the war, it had exceedingly favoured, he levelled it with the ground after it had been delivered up to the soldiers to be plundered. The citizens likewise, being more strongly attached to that prince than any of the other Numidians, on account of the extraordinary privileges he indulged them with, and of course bearing a more implacable hatred to the Romans, he put to the sword or sold for slaves. The true motive of the consul's conduct on this occasion seems here to be assigned; though we are told by Sallust, in conformity to the Roman genius, that neither avarice nor resentment prompted him to so barbarous an action, but only a desire to strike a terror into the Numidians.

The Numidians, ever after this exploit, dreaded the very name of Marius; who now, in his own opinion, had eclipsed the glory of all his predecessor's great achievements, particularly the reduction of Thala, a city, in strength and situation, nearly resembling Capsa. Following his blow, he gradually presented himself before most of the places of strength in the enemy's country; many of which either opened their gates, or were abandoned, at his approach, being terrified with what had happened to the unfortunate citizens of Capsa. Others taken by force, he laid in ashes; and in short, filled the greatest part of Numidia with blood, horror, and confusion. Then, after an obstinate defence, he reduced a castle that seemed impregnable, seated not far from Mulucha, where Jugurtha kept part of his treasures. In the mean time, Jugurtha not being able to prevail upon Bocchus, by his repeated solicitations, to advance into Numidia, where he found himself greatly pressed, was obliged to have recourse to his usual method of bribing the Mauritanian ministers, in order to put that prince in motion. He also promised him a third part of his kingdom, provided they could either drive the Romans out of Africa, or get all the Numidian dominions confirmed to him by treaty.

So considerable a cession could not fail of engaging Bocchus to support Jugurtha with his whole power. The two African monarchs therefore, having joined their forces, surprised Marius near Cirta as he was going into winter quarters. The Roman general was so pushed on this occasion, that the barbarians thought themselves certain of victory, and doubted not but they

18 Jugurtha entirely defeated.

should be able to extinguish the Roman name in Numidia. But their incaution and too great security enabled Marius to give them a total defeat; which was followed four days after by so complete an overthrow, that their numerous army, consisting of 90,000 men, by the accession of a powerful corps of Moors, commanded by Bocchus's son Volux, was entirely ruined. Sylla, Marius's lieutenant, most eminently distinguished himself in the last action, which laid the foundation of his future greatness. Bocchus, now looking upon Jugurtha's condition as desperate, and not being willing to run the risk of losing his dominions, showed a disposition to clap up a peace with Rome. However, the republic gave him to understand, that he must not expect to be ranked amongst its friends, till he had delivered up into the consul's hands Jugurtha, the inveterate enemy of the Roman name. The Mauritanian monarch, having entertained a high idea of an alliance with that state, resolved to satisfy it in this particular; and was confirmed in his resolution by one Dabar, a Numidian prince, the son of Massugrada, and descended by his mother's side from Masinissa. Being closely attached to the Romans, and extremely agreeable to Bocchus on account of his noble disposition, he defeated all the intrigues of Aspar, Jugurtha's minister. Upon Sylla's arrival at the Mauritanian court, the affair there seemed to be entirely settled. However, Bocchus, who was for ever projecting new designs, and, like the rest of his countrymen, in the highest degree perfidious, debated within himself, whether he should sacrifice Sylla or Jugurtha, who were both then in his power. He was a long time fluctuating with uncertainty, and combated by a contrariety of sentiments. The sudden changes which displayed themselves in his countenance, his air, and his whole person, evidently showed how strongly his mind was agitated. But at last he returned to his first design, to which the bias of his mind seemed naturally to lead him. He therefore delivered up Jugurtha into the hands of Sylla, to be conducted to Marius; who, by that successful event, happily terminated this dangerous war. The kingdom of Numidia was now reduced to a new form: Bocchus, for his important services, had the country of the Massæsyli, contiguous to Mauritania, assigned him: which, from this time, took the name of *New Mauritania*. Numidia Propria, or the country of the Massyli, was divided into three parts; one of which was given to Hiempsal, another to Mandrestal, both descendants of Masinissa; and the third the Romans annexed to Africa Propria, or the Roman province adjacent to it. What became of Jugurtha after he had graced Marius's triumph, at which ceremony he was led in chains, together with his two sons, through the streets of Rome, we have already laid before our readers. See JUGURTHA.

19 Transactions after the death of Jugurtha.

Jugurtha's two sons survived him, but spent their lives in captivity at Venusia. However, one of them, named *Oxyntas*, was, for a short time, released from his confinement by Aponius, who besieged Acerræ in the war between the Romans and the Italian allies. That general brought this prince to his army, where he treated him as king, in order to draw the Numidian forces off from the Roman service. Accordingly those Numidians no sooner heard that the son of their old king was fighting for the allies, than they began to desert by companies; which obliged Julius Cæsar the consul to part with all his Numidian cavalry, and send them back into Africa. Some few years after this event, Pompey defeated Cneius Domitius Ahenobarbus, and Hiarbas one of the kings of Numidia, killing 17,000 of their men upon the spot. Not satisfied with this victory, that general pursued the fugitives to their camp, which he soon forced, put Domitius to the sword, and took Hiarbas prisoner. He then reduced that part of Numidia which belonged to Hiarbas, who seems to have succeeded Mandrestal above-mentioned; and gave it to Hiempsal, a neighbouring Numidian prince, descended from Masinissa, who had always opposed the Marian faction.

20 Cæsar insults Juba.

Suetonius informs us, that a dispute happened between Hiempsal and one Masintha, a noble Numidian, whom, it is probable, he had in some respect injured, when Julius Cæsar first began to make a figure in the world. The same author adds, that Cæsar warmly espoused

Numidia. espoused the cause of Masintha, and even grossly insulted Juba, Hiempsal's son, when he attempted to vindicate his father's conduct on this occasion. He pulled him by the beard, than which a more unpardonable affront could not be offered to an African. In short, he screened Masintha from the insults and violence of his enemies; from whence a reason may be assigned for Juba's adhering so closely afterwards to the Pompeian faction.

21 Juba defeats one of Cæsar's lieutenants.

In consequence of the indignity Cæsar had offered Juba, and the disposition it had occasioned, that prince did Cæsar great damage in the civil wars betwixt him and Pompey. By a stratagem he drew Curio, one of his lieutenants, into a general action, which it was his interest at that time to have avoided. He caused it to be given out all over Africa Propria and Numidia, that he was retired into some remote country at a great distance from the Roman territories. This coming to Curio's ears, who was then besieging Utica, it hindered him from taking the necessary precautions against a surprise. Soon after, the Roman general receiving intelligence that a small body of Numidians was approaching his camp, he put himself at the head of his forces in order to attack them, and, for fear they should escape, began his march in the night, looking upon himself as sure of victory. Some of their advanced posts he surprised asleep, and cut them to pieces; which still farther animated him. In short, about daybreak he came up with the Numidians, whom he attacked with great bravery, though his men were then fasting, and vastly fatigued by their forced and precipitate march. In the mean time, Juba, who immediately after the propagation of the rumour above mentioned, had taken care to march privately, with the main body of the Numidian army, to support the detachment sent before to decoy Curio, advanced to the relief of his men. The Romans had met with a great resistance before he appeared; so that he easily broke them, killed Curio, with a great part of his troops, upon the spot, pursued the rest to their camp, which he plundered, and took many of them prisoners. Most of the fugitives, who endeavoured to make their escape on board the ships in the port of Utica, were either slain by the pursuers, or drowned. The remainder fell into the hands of Varus, who would have saved them; but Juba, who arrogated to himself the honour of this victory, ordered most of them to be put to the sword.

22 Juba overthrown by Cæsar.

This victory infused new life and vigour into the Pompeian faction, who thereupon conferred great honours upon Juba, and gave him the title of *king of all Numidia*. But Cæsar and his adherents declared him an enemy to the state of Rome, adjudging to Bocchus and Bogud, two African princes entirely in their interest, the sovereignty of his dominions. Juba afterwards, uniting his forces with those of Scipio, reduced Cæsar to great extremities, and would in all probability have totally ruined him, had he not been relieved by Publius Sittius. That general, having formed a considerable corps, consisting of Roman exiles, and Mauritanian troops sent him by Bocchus, according to Dio, or, as Cæsar will have it, Bogud, made an irruption into Gætulia and Numidia, whilst Juba was employed in Africa Propria. As he ravaged these countries in a dreadful manner, Juba immediately returned with the best part of his army, to preserve them from utter destruction. However, Cæsar knowing his horse to be afraid of the enemy's elephants, did not think proper to attack Scipio in the absence of the Numidian, till his own elephants, and a fresh reinforcement of troops, hourly expected, arrived from Italy. With this accession of strength, he imagined himself able to give a good account, both of the Roman forces with which he was to cope, and the barbarians. In the mean time Scipio despatched reiterated expresses to Juba to hasten to his assistance; but could not prevail upon him to move out of Numidia, till he had promised him the possession of all the Roman dominions in Africa, if they could from thence expel Cæsar. This immediately put him in motion; so that, having sent a large detachment to make head against Sittius, he marched with the rest of his troops to assist Scipio. However, Cæsar at last overthrew Scipio, Juba, and Labienus, near the town of Thapsus, and forced all their camps. As Scipio was the first surprised and defeated, Juba fled into Numidia without waiting for Cæsar's approach; but the body of the Numidians detached against Sittius, having been broken and dispersed by that general, none of his subjects there would receive him. Abandoned therefore to despair, he sought death in a single combat with Petreius, and, having killed him, caused himself to be despatched by one of his slaves.

23 Numidia reduced to the form of a province.

After this decisive action, and the reduction of Africa Propria, Cæsar made himself master of Numidia, which he reduced to a Roman province, appointing Crispus Sallustius to govern it in quality of proconsul, with private instructions to pillage and plunder the inhabitants, and, by that means, put it out of their power ever to shake off the Roman yoke. However, Bocchus and Bogud still preserved a sort of sovereignty in the country of the Massæsyli and Mauritania, since the former of those princes, having deserted Cæsar, sent an army into Spain to assist the Pompeians; and the latter, with his forces, determined victory to declare for Cæsar at the ever memorable battle of Munda. Bogud, afterwards siding with Antony against Octavius, sent a body of forces to assist him in Spain; at which time the Tingitanians revolting from him, Bocchus, with an army composed of Romans in the interest of Octavius, who passed over from Spain into Africa, and his own subjects, possessed himself of Mauritania Tingitana. Bogud fled to Antony; and Octavius, after the conclusion of the war, honoured the inhabitants of Tingi with all the privileges of Roman citizens. He likewise confirmed Bocchus king of Mauritania Cæsariensis, or the country of the Massæsyli, in the possession of Tingitana, which he had conquered, as a reward for his important services. In this he imitated the example of his great predecessor Julius Cæsar, who divided some of the fruitful plains of Numidia among the soldiers of P. Sittius, who had conquered great part of that country, and appointed Sittius himself sovereign of that district. Sittius, as has been intimated above, having taken Cirta, killed Sabura, Juba's general, entirely dispersed his forces, and either cut off or taken prisoners most of the Pompeian fugitives that escaped from the battle of Thapsus, highly deserved to be distinguished in so eminent a manner. After Bocchus's death, Mauritania and the Massæsylian Numidia were in all respects considered as Roman provinces.

Numidia, Numismatographia.

NUMISMATOGRAPHIA, a term used for the description

description and knowledge of ancient coins and medals, whether of gold, silver, or brass. See COINS and MEDALS.

NUMITOR, the son of Procas king of Alba, and the brother of Amulius. Procas before his death made him and Amulius joint heirs to the crown, on condition of their reigning annually by turns: but Amulius, on getting possession of the throne, excluded Numitor, whose son Lausus he ordered to be put to death, and obliged Rhea Sylvia, Numitor's only daughter, to become a vestal. This princess becoming pregnant, declared that she was with child by the god Mars; and afterwards brought forth Remus and Romulus, who at length killed Amulius, and restored Numitor to the throne, 754 B. C. See REMUS and ROMULUS.

NUMMUS, a piece of money, otherwise called *sestertius*.

NUN, the son of Elishamah, and father of Joshua, of the tribe of Ephraim. The Greeks gave him the name of *Nane* instead of Nun. This man is known in sacred history only by being the father of Joshua.

NUN, a woman, in several Christian countries, who devotes herself, in a cloister or nunnery, to a religious life. See the article MONK.

There were women, in the ancient Christian church, who made public profession of virginity, before the monastic life was known in the world, as appears from the writings of Cyprian and Tertullian. These, for distinction's sake, are sometimes called *ecclesiastical virgins*, and were commonly enrolled in the canon or matricula of the church. They differed from the monastic virgins chiefly in this, that they lived privately in their fathers houses, whereas the others lived in communities: but their profession of virginity was not so strict as to make it criminal for them to marry afterwards, if they thought fit. As to the consecration of virgins, it had some things peculiar in it: it was usually performed publicly in the church by the bishop. The virgin made a public profession of her resolution, and then the bishop put upon her the accustomed habit of sacred virgins. One part of this habit was a veil, called the *sacrum velamen;* another was a kind of mitre or coronet worn upon the head. At present, when a woman is to be made a nun, the habit, veil, and ring of the candidate are carried to the altar; and she herself, accompanied by her nearest relations, is conducted to the bishop, who, after mass and an anthem, (the subject of which is, "that she ought to have her lamp lighted, because the bridegroom is coming to meet her)," pronounces the benediction: then she rises up, and the bishop consecrates the new habit, sprinkling it with holy water. When the candidate has put on her religious habit, she presents herself before the bishop, and sings, on her knees, *Ancilla Christi sum*, &c.; then she receives the veil, and afterwards the ring, by which she is married to Christ; and lastly, the crown of virginity. When she is crowned, an anathema is denounced against all who shall attempt to make her break her vows. In some few instances, perhaps, it may have happened that nunneries, monasteries, &c. may have been useful as well to morality and religion as to literature: in the gross, however, they have been highly prejudicial; and however well they might be supposed to do when viewed in theory, in fact they are unnatural and impious. It was surely far from the intention of Providence to seclude youth and beauty in a cloistered ruin, or to deny them the innocent enjoyment of their years and sex.

NUNCIO, or NUNTIO, an ambassador from the pope to some Catholic prince or state, or a person who attends on the pope's behalf at a congress, or an assembly of several ambassadors.

NUNCUPATIVE, in the schools, something that is only nominal, or has no existence but in name.

NUNCUPATIVE Will or *Testament*, a will made verbally, and not put in writing. See the articles WILL and TESTAMENT.

NUNDINA, a goddess among the ancient heathens, supposed to have the care of the purification of infants. And because male infants were purified nine days after their birth, her name is derived from *nonus*, or the ninth, though female infants were purified the eighth day; which purification was called *lustration* by the Romans.

NUNDINAL, *Nundinalis*, a name which the Romans gave to the eight first letters of the alphabet used in their kalendar.

This series of letters, A, B, C, D, E, F, G, H, is placed and repeated successively from the first to the last day of the year: one of these always expressed the market days, or the assemblies called *nundinæ, quasi novendinæ*, because they returned every nine days. The country people, after working eight days successively, came to town the ninth, to sell their several commodities, and to inform themselves of what related to religion and government. Thus the nundinal day being under A on the first, ninth, seventeenth, and twenty-fifth days of January, &c. the letter D will be the nundinal letter of the year following. These nundinals bear a very great resemblance to the dominical letters, which return every eight days, as the nundinals did every nine.

NUNDOCOMAR, a Rajah in Bengal, and head of the Bramins, who, in 1775, was condemned to an ignominious death by English laws newly introduced, in an English court of justice newly established, for a forgery charged to have been committed by him many years before. That he was guilty of the deed cannot be questioned; but there was surely something hard in condemning a man by an *ex post facto* law. He bore his fate with the utmost fortitude, in the full confidence that his soul would soon be reunited to the universal spirit whence it had sprung. See METAPHYSICS, Part III. Chap. IV. *Of the Immortality of the Soul.*

MONTE NUOVO, in the environs of Naples, blocks up the valley of Averno. "This mountain (Mr Swinburne tells us) arose in the year 1538; for after repeated quakings, the earth burst asunder, and made way for a deluge of hot ashes and flames, which rising extremely high, and darkening the atmosphere, fell down again and formed a circular mound four miles in circumference, and 1000 feet high, with a large cup in the middle. The wind rising afterwards, wafted the lighter particles over the country, blasted vegetation, and killed the animals who grazed; the consequence was, that the place was deserted, till Don Pedro de Toledo, viceroy of Naples, encouraged the inhabitants by example and otherwise to return.

"Part of Monte Nuovo is cultivated, but the larger portion of its declivity is wildly overgrown with prickly broom, and rank weeds that emit a very fetid sulphureous

Nuptial rites, Nuremberg.

reous ſmell. The crater is ſhallow, its inſide clad with ſhrubs, and the little area at the bottom planted with fig and mulberry trees; a moſt ſtriking ſpecimen of the amazing viciſſitudes that take place in this extraordinary country. I ſaw no traces of lava or melted matter, and few ſtones within.

"Near the foot of this mountain the ſubterraneous fires act with ſuch immediate power, that even the ſand at the bottom of the ſea is heated to an intolerable degree."

NUPTIAL RITES, the ceremonies attending the ſolemnization of marriage, which are different in different ages and countries. We cannot omit here a cuſtom which was practiſed by the Romans on theſe occaſions; which was this: Immediately after the chief ceremonies were over, the new married man threw *nuts* about the room for the boys to ſcramble for. Various reaſons have been aſſigned for it; but that which moſt generally prevails, and ſeems to be the moſt juſt, is, that by this act the bridegroom ſignified his reſolution to abandon trifles, and commence a ſerious courſe of life; whence *nucibus relictis* in this ſenſe became a proverb. They might alſo be an emblem of fertility.

The ancient Greeks had a perſon to conduct the bride from her own to the bridegroom's houſe; and hence he was called by the Greeks *Nymphagogi*, which term was afterwards uſed both by the Romans and the Jews.

NUREMBERG, an imperial city of Germany, capital of a territory of the ſame name, ſituated in E. Long. 11. N. Lat. 47. 30. It ſtands on the Regnitz, over which it has ſeveral bridges, both of wood and ſtone, at the bottom of a hill, 60 miles from Augſburg, 87 from Munich, 46 from Wurtzburg, and 50 from Ratiſbon; and is thought by ſome to be the Segodunum, and by others the Caſtrum Noricum of the ancients.

The city has derived its name from the hill, upon which ſtands this caſtle, called, in Latin, Caſtrum Noricum, round which the city was begun to be built, and where the emperors formerly lodged; and here they lodge ſtill, when they paſs by that city. They there preſerve, as precious relicks, the crown, ſceptre, clothes, buſkins, and other ornaments of Charlemagne (A), which ſerved alſo the emperor Leopold, when he went thither after his election, to receive the homage of the city. The ſmall river Regnitz, which runs through it, and thoſe of Rednitz and Schwarzack, which paſs by its walls, furniſh the inhabitants, beſides other advantages, with the means of making all ſorts of ſtuffs, dyes, and other manufactures (B), and toys, which are carried and ſold even in the Indies.

Nuremberg.

It is a large and well-built town, but not very populous. Its fortifications are a double wall, flanked with towers mounting cannon, and a deep ditch. The magiſtrates, and moſt of the inhabitants, are Lutherans. There are a great many churches and chapels in it. In that of St Sebald is a braſs monument of the ſaint; and a picture, repreſenting the creation of the world, by the celebrated Albert Durer, who was a native of the town; but the fineſt church in the town is that of St Giles. In that of the Holy Ghoſt are kept moſt of the jewels of the empire, together with the pretended ſpear with which our Saviour's ſide was pierced, a thorn of his crown, and a piece of the manger wherein he was laid. Here are alſo a great many hoſpitals, one in particular for foundlings, and another for pilgrims; with a gymnaſium, an anatomical theatre, a granary, a fine public library, the old imperial fortreſs or caſtle, ſome remains of the old citadel of the burgraves of Nuremberg, ſeveral Latin ſchools, an academy of painting, a well furniſhed arſenal, a Teutonic houſe in which the Roman Catholic ſervice is tolerated, and a mint. Mr Keyſler ſays, there are upwards of 500 ſtreets in it, about 140 fountains, 16 churches, 44 religious houſes, 12 bridges, 10 market places, and 25,000 inhabitants; and that its territories, beſides the capital and four other towns, contain above 500 villages, and about 160 mills on the Regnitz. The trade of this city, though upon the decline, is ſtill very great, many of its manufactures being ſtill exported to all parts of the world; among which may be reckoned a great variety of curious toys in ivory, wood, and metal, already mentioned. The city has alſo diſtinguiſhed itſelf in the arts of painting and engraving. When the emperor Henry VI. aſſiſted at a tournament in Nuremberg, he raiſed 38 burghers to the degree of nobility, the deſcendants of whom are called *patricians*, and have the government of the city entirely in their hands; the whole council, except eight maſters of companies, who are ſummoned only on extraordinary occaſions, conſiſting of them. Among the fine braſs cannon in the arſenal, is one that is charged at the breech, and may be fired eight times in a minute; and two that carry balls of eighty pounds. The city keeps, in conſtant pay, ſeven companies, conſiſting each, in time of peace, of 100 men, but, in time of war, of 185; two troops of cuiraſſiers, each conſiſting of 85 men; and two companies of invalids. There are alſo 24 companies of burghers, well armed and diſciplined. On the new bridge, which is ſaid to have coſt 100,000 guilders, are two pyramids, on the top of one of which is a dove with an olive branch in her bill, and on the other an imperial black eagle. Muſic alſo flouriſhes greatly in Nuremberg; and thoſe who delight in mechanic

(A) Theſe ornaments are, a mitred crown, enriched with rubies, emeralds, and pearls; the dalmatic of Charlemagne, richly embroidered; the imperial mantle powdered with embroidered eagles, and its border thick ſet with large emeralds, ſapphires, and topazes; the buſkins covered with plates of gold; the gloves embroidered; the apple, the golden ſceptre, and ſword. The ancient cuſtom of the empire is, that the emperor is bound to aſſemble in this city the firſt diet that he holds after his election and coronation.

(B) There is in Nuremberg, and in the neighbouring villages depending upon it, an infinite number of workmen, very ingenious in making ſeveral kinds of toys of wood, which are carried through all the fairs of Germany, and from thence through all Europe. Theſe toys are called Nurembergs; and they have ſo great a ſale, that it even exceeds deſcription. This employment affords a livelihood to the greateſt part of the inhabitants of the city; and they make a very conſiderable profit from this traffic.

Nursery, Nursing. mechanic arts and manufactures cannot anywhere better gratify their curiosity. As an imperial city, it has a seat and voice at the diets of the empire and circle, paying to the chamber of Wetzlar 812 rixdollars each term. The territory belonging to the city is pretty large, containing, besides two considerable forests of pine, called the *Sibald* and *Laurence forests*, several towns and villages.

We have mentioned already that certain families called patricians, to the exclusion of the rest, possess the offices of the senate. They are composed of 42 persons (C), over which two castellans, or perpetual seneschals, preside, the first of whom has his residence in the castle. These castellans assemble sometimes in the castle, with five or six of the chief members, to hold a secret council (D). And, as this city glories in being one of the first which embraced Lutheranism, it preserves the privilege of that in civil matters, not admitting any Catholics to the magistracy or freedom of the town; the Catholics there having the liberty only of remaining under the protection of the rest, and performing their religious worship in a commandery of Malta, and this but at certain hours, not to disturb the Lutherans, who likewise assemble there, although in possession of all the other churches.

This city is particularly noted for its antiquity, grandeur, fortifications, its triple walls of hewn stone, its large and deep moat, its fine houses, large churches, its wide streets, always clean, and for its curious and large library, and its magazine stored with every thing proper for its defence.

NURSERY, in *Gardening*, is a piece of land set apart for raising and propagating all sorts of trees and plants to supply the garden and other plantations.

NURSING OF CHILDREN. See LACTATIO.

The following observations and directions are said to be the result of long experience †. The child should be laid (the first month) upon a thin mattress, rather longer than itself, which the nurse will keep upon her lap, that the child may always lie straight, and only sit up as the nurse slants the mattress. To set a child quite upright before the end of the first month, hurts the eyes, by making the white part of the eye appear below the upper eyelid. Afterwards the nurse will begin to set it up and dance it by degrees. The child must be kept as dry as possible.

† *An. Reg.* vol. vi. p. 130.

The clothing should be very light, and not much longer than the child, that the legs may be got at with ease, in order to have them often rubbed in the day with a warm hand or flannel, and in particular the inside of them.

Rubbing a child all over takes off scurf, and makes the blood circulate. The one breast should be rubbed with the hands one way, and the other the other way, night and morning at least.

The ankle bones and inside of the knees should be rubbed twice a day; this will strengthen those parts, and make the child stretch its knees and keep them flat, which is the foundation of an erect and graceful person. Nursing.

A nurse ought to keep a child as little in her arms as possible, lest the legs should be cramped, and the toes turned inwards. Let her always keep the child's legs loose. The oftener the posture is changed, the better.

Tossing a child about, and exercising it in the open air in fine weather, is of the greatest service. In cities, children are not to be kept in hot rooms, but to have as much air as possible.

Want of exercise is the cause of large heads, weak and knotted joints, a contracted breast, which occasions coughs and stuffed lungs, an ill shaped person, and waddling gait, besides a numerous train of other ills.

The child's flesh is to be kept perfectly clean, by constantly washing its limbs and likewise its neck and ears; beginning with warm water, till by degrees it will not only bear, but like to be washed with cold water.

Rising early in the morning is good for all children, provided they awake of themselves, which they generally do: but they are never to be waked out of their sleep, and as soon as possible to be brought to regular sleeps in the day.

When laid in bed or cradle, their legs are always to be laid straight.

Children, till they are two or three years old, must never be suffered to walk long enough at a time to be weary.

Girls might be trained to the proper management of children, if a premium were given in free schools, workhouses, &c. to those that brought up the finest child to one year old.

If the mother cannot suckle the child, get a wholesome cheerful woman, with young milk, who has been used to tend young children. After the first six months, small broths, and innocent foods of any kind, may do as well as living wholly upon milk.

A principal thing to be always attended to is, to give young children constant exercise, and to keep them in a proper posture.

With regard to the child's dress in the day, let it be a shirt; a petticoat of fine flannel, two or three inches longer than the child's feet, with a dimity top (commonly called a *bodice coat*), to tie behind; over that a surcingle made of fine buckram, two inches broad, covered over with satin or fine ticken, with a ribbon fastened to it to tie it on, which answers every purpose of stays, and has none of their inconveniences. Over this put a robe, or a slip and frock, or whatever you like best; provided it is fastened behind, and not much longer than the child's feet, that their motions may be strictly observed.

Two

(C) Of these 42 members, there are only 34 chosen from the patrician families; the other eight are taken from among the burghers, and make in a manner a small separate body.

(D) This secret council is composed of seven principal chiefs of the republic, and for that reason is called *septemvirate*. It determines the most important affairs; and is the depository of the precious stones of the empire, of the imperial crown, the ensigns, seals, and keys of the city.

Two caps are to be put on the head, till the child has got moſt of its teeth.

The child's dreſs for the night may be a ſhirt, a blanket to tie on, and a thin gown to tie over the blanket.

NUSANCE, or NUISANCE, in *Law*, a thing done to the annoyance of another.

Nuiſances are either public or private.—A public nuiſance is an offence againſt the public in general, either by doing what tends to the annoyance of all the king's ſubjects, or by neglecting to do what the common good requires: in which caſe, all annoyances and injuries to ſtreets, highways, bridges, and large rivers, as alſo diſorderly alehouſes, bawdy-houſes, gaming houſes, ſtages for rope-dancers, &c. are held to be common nuiſances.—A private nuiſance is, when only one perſon or family is annoyed by the doing of any thing; as where a perſon ſtops up the light of another's houſe, or builds in ſuch a manner that the rain falls from his houſe upon his neighbour's.

NUT, among botaniſts, denotes a PERICARPIUM of an extraordinary hardneſs, encloſing a kernel or ſeed.

NUTATION, in *Astronomy*, a kind of tremulous motion of the axis of the earth, whereby, in each annual revolution, it is twice inclined to the ecliptic, and as often returns to its former poſition.

NUTCRACKER. See CORVUS, ORNITHOLOGY *Index*.

NUTHATCH. See SITTA, ORNITHOLOGY *Index*.

NUTMEG, the fruit of a tree, and a well known ſpice. See MYRISTICA.

NUTRITION, in the animal economy, is the repairing the continual loſs which the different parts of the body undergo. The motion of the parts of the body, the friction of theſe parts with each other, and eſpecially the action of the air, would deſtroy the body entirely, if the loſs was not repaired by a proper diet, containing nutritive juices; which being digeſted in the ſtomach, and afterwards converted into chyle, mix with the blood, and are diſtributed through the whole body for its nutrition.

In young perſons, the nutritive juices not only ſerve to repair the parts that are damaged, but alſo to increaſe them; which is called *growth*.

In grown perſons, the cuticle is everywhere conſtantly deſquamating, and again renewing; and in the ſame manner the parts rubbed off, or otherwiſe ſeparated from the fleſhy parts of the body, are ſoon ſupplied with new fleſh; a wound heals, and an emaciated perſon grows plump and fat.

Buffon, in order to account for nutrition, ſuppoſes the body of an animal or vegetable to be a kind of mould, in which the matter neceſſary to its nutrition is modelled and aſſimilated to the whole. But (continues he) of what nature is this matter which an animal or vegetable aſſimilates to its own ſubſtance? What power is it that communicates to this matter the activity and motion neceſſary to penetrate this mould? and, if ſuch a force exiſt, would it not be by a ſimilar force that the internal mould itſelf might be reproduced?

As to the firſt queſtion, he ſuppoſes that there exiſts in nature an infinite number of living organical parts, and that all organized bodies conſiſt of ſuch organical parts; that their production coſts nature nothing, ſince

their exiſtence is conſtant and invariable; ſo that the matter which the animal or vegetable aſſimilates to its ſubſtance, is an organical matter of the ſame nature with that of the animal or vegetable, which conſequently may augment its volume without changing its form or altering the quality of the ſubſtance in the mould.

As to the ſecond queſtion: There exiſt (ſays he) in nature certain powers, as that of gravity, that have no affinity with the external qualities of the body, but act upon the moſt intimate parts, and penetrate them throughout, and which can never fall under the obſervation of our ſenſes.

And as to the third queſtion, he anſwers, that the internal mould itſelf is reproduced, not only by a ſimilar power, but it is plain that it is the very ſame power that cauſes the unfolding and reproduction thereof: for it is ſufficient (proceeds he), that in an organized body that unfolds itſelf, there be ſome part ſimilar to the whole, in order that this part may one day become itſelf an organized body, altogether like that of which it is actually a part.

NUX MOSCHATA. See MYRISTICA.

NUX Piſtachia. See PISTACHIA, BOTANY *Index*.

NUX Vomica, a flat, compreſſed, round fruit, about the breadth of a ſhilling, brought from the Eaſt Indies. It is found to be a certain poiſon for dogs, cats, &c. and it is not to be doubted that it would alſo prove fatal to mankind. Its ſurface is not much corrugated; and its texture is firm like horn, and of a pale grayiſh-brown colour. It is ſaid to be uſed as a ſpecific againſt the bite of a ſpecies of water-ſnake. It is conſiderably bitter and deleterious; but has been uſed in doſes from five to ten grains twice a-day or ſo, in intermittents, particularly obſtinate quartans, and in contagious dyſentery. The *ſtrychnus Ignatii* is a tree of the ſame kind, producing gourd-like fruit, the ſeeds of which are improperly called St Ignatius's beans. Theſe, as alſo the woods or roots of ſome ſuch trees, called *lignum colubrinum*, or *ſnakewood*, are very narcotic bitters, like the nux vomica.

NUYTS, PETER, a native of Holland, and a leading character in that extraordinary tranſaction which happened between the Japaneſe and the Dutch about the year 1628. In 1627 Nuyts arrived in Batavia from Holland, and was in the ſame year appointed ambaſſador to the emperor of Japan by the governor and council of Batavia.

He repaired to that empire in 1628; and being a man of a haughty diſpoſition, and extremely vain, he believed it practicable to paſs upon the natives for an ambaſſador from the king of Holland. Upon his aſſuming this title he was much more honourably received, careſſed, and reſpected, than former miniſters had been. But he was ſoon detected, reprimanded, and reproached in the ſevereſt manner, ſent back to the port, and ordered to return to Batavia with all the circumſtances of diſgrace imaginable; notwithſtanding which, his intereſt was ſo great, that, inſtead of being puniſhed as he deſerved, he was immediately afterwards promoted to the government of the iſland of Formoſa, of which he took poſſeſſion the year following.

He entered upon the adminiſtration of affairs in that iſland with the ſame diſpoſition that he had ſhown while ambaſſador, and with the moſt implacable reſentment againſt

against the Japanese; neither was it long before an opportunity offered, as he thought, of revenging himself to the full. Two large Japanese ships, with upwards of 500 men on board, came into the port; upon which he took it into his head to disarm and unrig them, in the same manner as the Dutch vessels are treated at Japan. The Japanese did all they could to defend themselves from this ill usage; but at last, for want of water, they were forced to submit. Governor Nuyts went still farther. When they had finished their affairs at Formosa, and were desirous of proceeding, according to their instructions, to China, he put them off with fair words and fine promises till the monsoon was over. They began then to be very impatient, and desired to have their cannon and sails restored, that they might return home; but the governor had recourse to new artifices, and, by a series of false promises, endeavoured to hinder them from making use of the season proper for that voyage.

The Japanese, however, soon perceived his design; and at length, by a bold attempt, accomplished what by fair means and humble entreaty they could not obtain; for, by a daring and well concerted effort, they took him prisoner, and made him and one of the council sign a treaty for securing their liberty, free departure, and indemnity, which was afterwards ratified by the whole council. Nuyts was first confined in Batavia, and afterwards delivered up to the Japanese, notwithstanding the most earnest entreaties on his part to be tried, and even to suffer any kind of death where he was, rather than to be sent to Japan. He was sent there, however, in 1634. He was submitted to the mercy or discretion of the emperor; and the consequence was, that, though imprisoned, he was well used, and could go anywhere, provided his guards were with him, which was more than he could possibly have expected. He now looked for nothing but the continuance of his confinement for life. On a particular occasion, however, i. e. at the funeral of the emperor's father, at the request of the Dutch he was set free, and returned again to Batavia, to the surprise of that people, who, however, adopted ever after a very different conduct with respect to the Japanese.

NUZZER, or NUZZERANAH; a present or offering from an inferior to a superior. In Hindostan no man ever approaches his superior for the first time on business without an offering of at least a gold or silver rupee in his right hand; which, if not taken, is a mark of disfavour. Nuzzeranah is also used for the sum paid to the government as an acknowledgment for a grant of lands or any public office.

NYCHTHEMERON, among the ancients, signified the whole natural day, or day and night, consisting of 24 hours, or 24 equal parts. This way of considering the day was particularly adopted by the Jews, and seems to owe its origin to that expression of Moses, in the first chapter of Genesis, "the evening and the morning were the first day."—Before the Jews had introduced the Greek language into their discourse, they used to signify this space of time by the simple expression of a night and a day.

It is proper here to observe, that all the eastern countries reckoned any part of a day of 24 hours for a whole day; and say a thing that was done on the third or seventh day, &c. from that last mentioned, was done after three or seven days. And the Hebrews, having no word which exactly answers to the Greek Νυχθημερον, signifying "a natural day of 24 hours," use *night and day*, or *day and night*, for it. So that to say a thing happened after three days and three nights, was, with them, the same as to say it happened after three days, or on the third day. This, being remembered, will explain what is meant by "the Son of Man's being three days and three nights in the heart of the earth."

NYCTALOPIA. See MEDICINE, N° 361.

NYCTANTHES, ARABIAN JASMINE, a genus of plants, belonging to the diandria class, and in the natural method ranking with the 44th order, *Sepiariæ*. See BOTANY *Index*.

NYCTASTRATEGI, among the ancients, were officers appointed to prevent fires in the night, or to give alarm and call assistance when a fire broke out. At Rome they had the command of the watch, and were call *nocturni triumviri*, from their office and number.

NYCTICORAX, the night raven; a species of ARDEA. See ARDEA, ORNITHOLOGY *Index*.

NYLAND, a province of Finland in Sweden, lying on the gulf of Finland, to the west of the province of Carelia.

NYL-GHAU, a species of quadruped belonging to the genus *Bos*, a native of the interior parts of India. See MAMMALIA *Index*.

NYMPH, in *Mythology*, an appellation given to certain inferior goddesses, inhabiting the mountains, wood, waters, &c. said to be the daughters of Oceanus and Tethys. All the universe was represented as full of these nymphs, who are distinguished into several ranks or classes. The general division of them is into celestial and terrestrial; the former of them were called *uraniæ*, and were supposed to be intelligences that governed the heavenly bodies or spheres. The terrestrial nymphs, called *epigeiæ*, presided over the several parts of the inferior world; and were divided into those of the water, and those of the earth. The nymphs of the water were the *oceanitides*, or nymphs of the ocean; the *nereids*, the nymphs of the sea; the *naiads* and *ephydriades*, the nymphs of the fountains; and the *limniades*, the nymphs of the lakes. The nymphs of the earth were the *oreades*, or nymphs of the mountains; the *napææ*, nymphs of the meadows: and the *dryads* and *hamadryads*, who were nymphs of the forests and groves. Besides these, we meet with nymphs who took their names from particular countries, rivers, &c. as the *cithæroniades*, so called from Mount Cithæron in Bœotia: the *dodonides*, from Dodona; *tiberiades*, form the Tiber, &c.—Goats were sometimes sacrificed to the nymphs; but their constant offerings were milk, oil, honey, and wine.

We have the following account of nymphs in Chandler's Greece. "They were supposed to enjoy longevity, but not to be immortal. They were believed to delight in springs and fountains. They are described as sleepless, and as dreaded by the country people. They were susceptible of passion. The Argonauts, it is related, landing on the shore of the Propontis to dine in their way to Colchos, sent Hylas, a boy, for water, who discovered a lonely fountain, in which the nymphs Eunica, Malis, and Nycheia, were preparing to dance; and these seeing him were enamoured, and, seizing him by the

hand

Nymph.

hand as he was filling his vafe, pulled him in. The deities, their copartners in the cave, are fuch as prefided with them over rural and paftoral affairs.

"The old Athenians were ever ready to cry out, A god! or a goddefs! The tyrant Pififtratus entered the city in a chariot with a tall woman dreffed in armour to refemble Minerva, and regained the Acropolis, which he had been forced to abandon, by this ftratagem; the people worfhipping, and believing her to be the deity whom fhe reprefented. The nymphs, it was the popular perfuafion, occafionally appeared; and nympholepfy is characterized as a frenzy, which arofe from having beheld them. Superftition difpofed the mind to adopt delufion for reality, and gave to a fancied vifion the efficacy of full conviction. The foundation was perhaps no more than an indirect, partial, or obfcure view of fome harmlefs girl, who had approached the fountain on a like errand with Hylas, or was retiring after fhe had filled her earthen pitcher.

"Among the facred caves on record, one on Mount Ida in Crete was the property of Jupiter, and one by Lebadea in Bœotia of Trophonius. Both thefe were oracular, and the latter bore fome refemblance to that we have defcribed. It was formed by art, and the mouth furrounded with a wall. The defcent to the landing place was by a light and narrow ladder, occafionally applied and removed. It was fituated on a mountain above a grove; and they related, that a fwarm of bees conducted the perfon by whom it was firft difcovered. But the common owners of caves were the nymphs, and thefe were fometimes local. On Cithæron in Bœotia, many of the inhabitants were poffeffed by nymphs called *Sphragitides*, whofe cave, once alfo oracular, was on a fummit of the mountain. Their dwellings had generally a well or fpring of water; the former often a collection of moifture condenfed or exuding from the roof and fides; and this, in many inftances, being pregnant with ftony particles, concreted, and marked its paffage by incruftation, the groundwork in all ages and countries of idle tales framed or adopted by fuperftitious and credulous people.

"A cave in Paphlagonia was facred to the nymphs who inhabited the mountains about Heraclea. It was long and wide, and pervaded by cold water, clear as cryftal. There alfo were feen bowls of ftone, and nymphs and their webs and diftaffs, and curious work, exciting admiration. The poet who has defcribed this grotto, deferves not to be regarded, as fervilely copying Homer; he may juftly lay claim to rank as an original topographer.

"The piety of Archidamus furnifhed a retreat for the nymphs, where they might find fhelter and provifion, if diftreffed; whether the fun parched up their trees, or Jupiter enthroned in clouds upon the mountain top fcared them with his red lightning and terrible thunder, pouring down a deluge of rain, or brightening the fummits with his fnow."

NYMPH, among naturalifts, that ftate of winged infects between their living in the form of a worm and their appearing in the winged or moft perfect ftate.

The eggs of infects are firft hatched into a kind of worms or maggots; which afterwards pafs into the nymph ftate, furrounded with fhells or cafes of their own fkins; fo that, in reality, thefe nymphs are only the embryo infects, wrapped up in this covering; from whence they at laft get loofe, though not without great difficulty.

Nymph, Nymphæum.

During this nymph ftate the creature lofes its motion. Swammerdam calls it *nympha aurelia*, or fimply *aurelia*; and others give it the name of *chryfalis*, a term of the like import. See the article CHRYSALIS.

NYMPH-Band, fituated about 10 leagues off the coaft of the county of Waterford, and province of Munfter in Ireland, is a great fifhing place, and 11 leagues S. S. E. from the high head of Dungarvan. It abounds with cod, ling, fkate, bream, whiting, and other fifh; which was difcovered by Mr Doyle, who on July 15. 1736 failed to it, in company with feven men, on board the Nymph, a fmall veffel of about 12 tons. This place is well adapted for a fifhing company, the great public advantages of which muft be very evident.

NYMPHÆ, in *Anatomy*, two membranaceous parts, fituated on each fide the rima. See ANATOMY *Index*.

NYMPHÆA, the WATER-LILY; a genus of plants belonging to the polyandria clafs, and in the natural method ranking under the 54th order, *Mifcellaneæ*. See BOTANY *Index*.

NYMPHÆA (amongft the ancients), doubtful what ftructures they were; fome take them to have been grottoes, deriving their name from the ftatues of the nymphs with which they were adorned; but that they were confiderable works appears from their being executed by the emperors, (Ammian, Victor, Capitolinus) or by the city prefects. In an infcription, the term is written *nymfium*. None of all thefe nymphæa has lafted down to our time. Some years fince, indeed, a fquare building of marble was difcovered between Naples and Vefuvius, with only one entrance, and fome fteps that went down to it. On the right hand as you enter, towards the head, there is a fountain of the pureft water; along which, by way of guard as it were, is laid a naked Arethufa of the whiteft marble; the bottom or ground is of variegated marble, and encompaffed with a canal fed by the water from the fountain: the walls are fet round with fhells and pebbles of various colours; by the fetting of which, as by fo many ftrokes in a picture, are expreffed the 12 months of the year, and the four political virtues; alfo the rape of Proferpine; Pan playing on his reed, and foothing his flock; befides the reprefentations of nymphs fwimming, failing, and wantoning on fifhes, &c.

It feems pretty evident that the nymphæa were public baths; for at the fame time that they were furnifhed with pleafing grottoes, they were alfo fupplied with cooling ftreams, by which they were rendered exceedingly delightful, and drew great numbers of people to frequent them. Silence feems to have been a particular requifite there, as appears by this infcription, *Nymphis, loci, bibe, lava, tace.* That building between Naples and Vefuvius, mentioned above, was certainly one of thefe nymphæa.

NYMPHÆUM, (Plutarch); the name of a facred place, near Apollonia in Illyricum, fending forth continually fire in detached ftreams from a green valley and verdant meadows. Dio Caffius adds, that the fire neither burns up nor parches the earth, but that herbs and trees grow and thrive near it, and therefore the place is called *nymphæum*: near which was an oracle of fuch a nature, that the fire, to fhow that the wifh was granted

granted, consumed the frankincense thrown into it: but repelled it, in case the desire was rejected. It was there that a sleeping satyr was once caught and brought to Sylla as he returned from the Mithridatic war. This monster had the same features as the poets ascribe to the satyr. He was interrogated by Sylla and by his interpreters; but his articulations were unintelligible; and the Roman spurned from him a creature which seemed to partake of the nature of a beast more than that of a man.

NYMPHÆUM, in antiquity, a public hall magnificently decorated, for entertainments, &c. and where those who wanted convenience at home held their marriage feasts; whence the name.

NYMPHIDIUS, SABINUS, a person of mean descent, but appointed by Nero colleague of Tigellinus in the command of the prætorian guards. About the time, however, that the German legions revolted from this despicable prince, he was also betrayed by Nymphidius and abandoned by his guards.

Nymphidius began now to entertain thoughts of seizing the sovereignty himself. However, he did not immediately declare his ambitious views; but pretending to espouse the cause of Galba, assured the guards that Nero was fled, and promised them such sums as neither Galba nor any other was able to discharge. This promise secured for the present the empire to Galba, occasioned afterwards the loss of it, and, finally, produced the destruction of Nymphidius and the guards themselves. After Nero's death, however, and on the acknowledgement of Galba as emperor, he renewed his ambition; and having, by his immense largesses, gained the affections of the prætorian guards, and persuading himself that Galba, by reason of his infirmities and old age, would never reach the capital, usurped all the authority at Rome. Presuming upon his interest, he obliged Tigellinus, who commanded, jointly with him, the prætorian guards, to resign his commission. He made several magnificent and extensive entertainments, inviting such as had been consuls or had commanded armies, distributed large sums among the people, and with shows and other diversions, which he daily exhibited, gained so great an interest with all ranks, that he already looked upon himself as sovereign. The senate, dreading his power, conferred extraordinary honours upon him, styled him their *protector*, attended him when he appeared in public, and had recourse to him for the confirmation of their decrees, as if he had been already invested with the sovereign power. This base compliance elated him to such a degree, that he usurped, not leisurely and by degrees, but all at once, an absolute authority. He acted as sovereign indeed, but he had not as yet openly declared his design of seizing the empire: his power however was great, and he used it in undermining Galba's power; he was, however, unsuccessful, and the disclosure of his designs was much against him. Galba was again acknowledged and proclaimed, and he, notwithstanding his artifices, detected and slain by the soldiers who were proclaiming Galba. See NERO.

NYON, a considerable town of Switzerland, in the canton of Bern, and capital of a bailiwick of the same name, with a castle. It stands delightfully upon the edge of the lake of Geneva, in the very point where it begins to widen, and in a most charming country commonly called *Pays de Vaud*. It was formerly called *Colonia Equestris Noiodunum;* and, as a proof of its antiquity, several Roman inscriptions, and other ancient remains have been frequently discovered in the outskirts of the town. E. Long. 5. 10. N. Lat. 46. 24.

NYSA, or NYSSA, in *Ancient Geography*, a town of Ethiopia, at the south of Egypt. Some place it in Arabia. This city, with another of the same name in India, was sacred to the god Bacchus, who was educated there by the nymphs of the place, and who received the name of *Dionysus*, which seems to be compounded of Διος and Νυσα, the name of his father, and that of the place of his education. The god made this place the seat of his empire, and the capital of the conquered nations of the east. According to some geographers, there were no less than ten places of this name. One of these was famous on the coast of Eubœa for its vines, which grew in such an uncommon manner, that if a twig was planted in the ground in the morning, it immediately produced grapes which were full ripe in the evening. A city of Thrace: another seated on the top of Mount Parnassus, and sacred to Bacchus.

NYSLOT, a strong town of Russia, in Livonia, with a castle; seated on the river Narva, among large marshes. E. Long. 26. 55. N. Lat. 58. 46.

NYSSA, a genus of plants, belonging to the polygamia class; and in the natural method ranking under the 12th order, *Holoraceæ*. See BOTANY *Index*.

NYU-CHE, or KIN, an empire which arose in Eastern Tartary in the beginning of the 13th century. From the founder of this empire the late Chinese emperor Kang-hi said that his family was descended. See CHINA and TARTARY.

O.

O, THE 14th letter and fourth vowel of our alphabet; pronounced as in the words *nose*, *rose*, &c.

The sound of this letter is often so soft as to require it double, and that chiefly in the middle of words; as *goose*, *reproof*, &c. And in some words, this *oo* is pronounced like *u* short, as in *blood*, *flood*, &c.

As a numeral, O was sometimes used for 11 among the ancients; and with a dash over it thus, Ō, for 11,000.

In the notes of the ancients, O. CON. is read *opus conductum;* O. C. Q. *opera consilioque;* O. D. M, *operæ, donum munus;* and Ō. LO. *opus locatum*.

The Greeks had two O's; viz. omicron, ο, and omega, ω; the first pronounced on the tip of the lips with a sharper sound; the second in the middle of the mouth, with a fuller sound, equal to *oo* in our language. The long and short pronunciation of our O are equivalent to the two Greek ones; the first, as in *suppose*; the second, as in *obey*.

O is usually denoted long by a servile *a* subjoined, as *moan;* or by *e* at the end of the syllable, as *bone;* when these vowels are not used, it is generally short.

Among the Irish, the letter O, at the beginning of the name of a family, is a character of dignity annexed to great houses. Thus, in the history of Ireland, we frequently meet with the *O Neals*, *O Carrols*, &c. considerable houses in that island.

Camden observes, that it is the custom of the lords of Ireland to prefix an O to their names, to distinguish them from the commonalty.

The ancients used O as a mark of triple time; from a notion that the ternary, or number 3, was the most perfect of numbers, and therefore properly expressed by a circle, the most perfect of figures.

It is not, strictly speaking, the letter O, but the figure of a circle ○, or double CƆ, by which the modern ancients in music used to express what they called *tempo perfetto*, or triple time. Hence the Italians call it *circolo.*

The seven antiphones, or alternate hymns of seven verses, &c. sung by the choir in the time of Advent, were formerly called *O*, from their beginning with such an exclamation.

O is an adverb of calling, or interjection of sorrow or wishing.

OAK, in *Botany*. See QUERCUS.

The oak has been long known by the title of *monarch of the woods*, and very justly. It was well known, and often very elegantly described, by the ancient poets. The following description from Virgil is exquisite:

Veluti annoso validam cùm robore quercum
Alpini Boreæ, nunc hinc, nunc flatibus illinc
Eruere inter se certant: it stridor, et alte
Consternunt terram concusso stipite frondes:
Ipsa hæret scopulis; et quantum vertice ad auras
Ætherias, tantum radice in Tartara tendit.

ÆN. iv. 441.

As o'er th' aerial Alps sublimely spread,
Some aged *oak* uprears his reverend head;
This way and that the furious tempests blow,
To lay the monarch of the mountains low;
Th' imperial plant, though nodding at the sound,
Though all his scatter'd honours strew the ground;
Safe in his strength, and seated on the rock,
In naked majesty defies the shock:
High as the head shoots tow'ring to the skies,
So deep the root in hell's foundation lies. PITT.

The ancient druids had a most profound veneration for oak trees. Pliny † says, that "the druids (as the Gauls call their magicians or wise men) held nothing so sacred as the misletoe, and the tree on which it grows, provided it be an oak. They make choice of oak groves in preference to all others, and perform no rites without oak leaves; so that they seem to have the name of druids from thence, if we derive their name from the Greek," &c. (See DRUIDS—Definition, and N° 11.) Maximus Tyrius says the Celtæ or Gauls worshipped Jupiter under the figure of a lofty oak (A).

† *Nat. Hist.* xvi. c. 44.

This useful tree grows to such a surprising magnitude, that were there not many well authenticated instances of them in our own country, they would certainly appear difficult of belief. In the 18th volume of the Gentleman's Magazine we have the dimensions of a leaf twelve inches in length and seven in breadth, and all the leaves of the same tree were equally large. On the estate of Woodhall, purchased in 1775 by Sir Thomas Rumbold, Bart. late governor of Madras, an oak was felled which sold for 43l. and measured 24 feet round. We are also told of one in Millwood forest, near Chaddesley, which was in full verdure in winter, getting its leaves again after the autumn ones fell off. In Hunter's Evelyn's Sylva, we have an account of a very remarkable oak at Greendale; which Gough, in his edition of Camden, thus minutely describes: "The Greendale oak, with a road cut through it, still bears one green branch. Such branches as have been cut or broken off are guarded from wet by lead. The diameter of this tree at the top, whence the branches issue, is 14 feet 2 inches; at the surface of the ground $11\frac{1}{2}$ feet; circumference there 35 feet; height of the trunk 53; height of the arch 10, width 6. Mr Evelyn mentions several more oaks of extraordinary size in Worksop park."

In the Gentleman's Magazine for 1773 we have an account of one differing very essentially from the common one; it is frequent about St Thomas in Devonshire, and is in that county called *Lucombe* oak, from one William Lucombe who successfully cultivated it near Exeter. It grows as straight and handsome as a fir; its leaves are evergreen, and its wood as hard as that of the common oak. Its growth is so quick, as to exceed in 20 or 30 years the altitude and girth of the common one at 100. It is cultivated in various places; Cornwall, Somersetshire, &c.

M. du Hamel du Monçeau, of the Royal Academy of Sciences at Paris (who wrote a treatise on husbandry), gave an account in the year 1749 of an oak which he had kept in water eight years, and which yielded fine leaves every spring. The tree had, he says, four or five branches; the largest 19 or 20 lines round, and more than 18 inches long. It throve more in the two first years than it would have done in the best earth; it afterwards lost its vigour, and rather decayed; which he attributed to a defect in the roots rather than to a want of aliment.

M.

(A) Camden informs us of a tradition (which, like most other traditions of this nature, seems to be founded in ignorance and fostered by credulity) respecting an oak near Malwood castle, where Rufus was killed, viz. that it budded on Christmas day, and withered before night. This tree, the same tradition reports to have been that against which Tyrrel's arrow glanced.

Oak. M. de Buffon made some experiments on oak trees; the result of which is recorded in the Gentleman's Magazine, 1754. He had compared barked with unbarked trees, and proves, we think with success, from a variety of trials, that timber barked and dried standing, is always heavier and considerably stronger than timber kept in its bark.

The bark of oak trees was formerly thought to be extremely useful in vegetation. One load (Mr Mills in his Treatise on Husbandry informs us) of oak bark, laid in a heap and rotted, after the tanners have used it for dressing of leather, will do more service to stiff cold land, and its effects will last longer, than two loads of the richest dung; but this has been strenuously controverted. (See *OAK Leaves.*)

The bark, in medicine, is also a strong astringent; and hence stands recommended in hæmorrhagies, alvine fluxes, and other preternatural or immoderate secretions; and in these it is sometimes attended with good effects. Some have alleged, that by the use of this bark every purpose can be answered which may be obtained from Peruvian bark. But after several very fair trials, we have by no means found this to be the case. Besides the bark, the buds, the acorns and their cups are used; as also the galls, which are excrescences caused by insects on the oaks of the eastern countries, of which there are divers sorts; some perfectly round and smooth, some rougher with small protuberances, but all generally having a round hole in them. All the parts of the oak are styptic, binding, and useful in all kinds of fluxes and bleedings, either inward or outward. The bark is frequently used in gargarisms, for the relaxation of the uvula, and for sore mouths and throats: it is also used in restringent clysters and injections, against the prolapsus uteri or ani. The acorns, beaten to powder, are frequently taken by the vulgar for pains in the side. The only officinal preparation is the aqua germinum quercus.

OAK Leaves. The use of oak bark in tanning, and in hot-beds, is generally known. For the latter of these purposes, however, oak leaves are now found to answer equally well, or rather better. In the notes to Dr Hunter's edition of Evelyn's Treatise on Forest Trees, we find the following directions for their use by W. Speechly: The leaves are to be raked up as soon as possible after they fall from the trees. When raked into heaps, they should immediately be carried into some place near the hot-houses, where they may lie to couch. Mr Speechly says, it was his custom to fence them round with charcoal hurdles, or any thing to keep them from being blown about the garden in windy weather. In this place they tread them well, and water them in case they happen to have been brought in dry. The heap is made six or seven feet thick, and covered over with old mats, or any thing else, to prevent the upper leaves from being blown away. In a few days the heap will come to a strong heat. For the first year or two in which he used these leaves, our author did not continue them in the heap longer than ten days or a fortnight: but by this method of management they settled so much when brought to the hot-house, that a supply was very soon required; and he afterwards found, that it was proper to let them remain five or six weeks in the heaps before they are brought to the hot-house. In getting them into the pine pots, if they appear dry, they are to be watered, and again trodden down exceedingly well, in layers, till the pits are quite full. The whole is then covered with tan bark, to the thickness of two inches, and well trodden down, till the surface becomes smooth and even. On this the pine pots are to be placed in the manner they are to stand, beginning with the middle row first, and filling up the spaces between the pots with tan. In this manner we are to proceed to the next row, till the whole be finished; and this operation is performed in the same manner as when tan only is used. The leaves require no farther trouble through the whole season; as they will retain a constant and regular heat for 12 months without stirring or turning; and our author informs us, that if he may judge from their appearance when taken out (being always entire and perfect), it is probable they would continue their heat through a second year; but, as an annual supply of leaves is easily obtained, the experiment is hardly worth making. After this, the pines will have no occasion to be moved but at stated times of their management, viz. at the shifting them in their pots, &c. when at each time a little fresh tan should be added to make up the deficiency arising from the settling of the beds; but this will be inconsiderable, as the leaves do not settle much after their long couching. During the first two years of our author's practice he did not use any tan, but plunged the pine pots into the leaves, and just covered the surface of the beds, when finished, with a little saw-dust, to give it a neatness. This method, however, was attended with one inconvenience; for, by the caking of the leaves they shrunk from the sides of the pots, whereby they became exposed to the air, and at the same time the heat of the beds was permitted to escape.

"Many powerful reasons (says Mr Speechly) may be given why oak leaves are preferable to tanners bark.

"1. They always heat regularly; for during the whole time that I have used them, which is near seven years, I never once knew of their heating with violence; and this is so frequently the case with tan, that I affirm, and indeed it is well known to every person conversant in the management of the hot-house, that pines suffer more from this one circumstance, than all the other accidents put together, insects excepted.—When this accident happens near the time of their fruiting, the effect is soon seen in the fruit, which is exceedingly small and ill-shaped. Sometimes there will be little or no fruit at all; therefore gardeners who make use of tan only for their pines, should be most particularly careful to avoid an over-heat at that critical juncture —the time of showing the fruit.

"2. The heat of oak leaves is constant; whereas tanner's bark generally turns cold in a very short time after its furious heat is gone off. This obliges the gardener to give it frequent turnings in order to promote its heating. These frequent turnings, not to mention the expence, are attended with the worst consequences; for by the continual moving of the pots backwards and forwards, the pines are exposed to the extremes of heat and cold, whereby their growth is considerably retarded; whereas, when leaves are used, the pines will have no occasion to be moved but at the times of potting, &c. The pines have one peculiar advantage in this undisturbed situation; their roots grow through the bottoms of the pots, and mat among the leaves in a ſurpriſing manner. From the vigour of the plants when in this ſituation, it is highly probable that the leaves, even in this ſtate, afford them an uncommon and agreeable nouriſhment.

"3. There is a ſaving in point of expence; which is no inconſiderable object in places where tan cannot be had but from a great diſtance.

"4. The laſt ground of preference is, that decayed leaves make good manure; whereas rotten tan is experimentally found to be of no value. I have often tried it both on ſand and clay, and on wet and dry land; and never could diſcover in any of my experiments, that it deſerved the name of a manure; whereas decayed leaves are the richeſt, and of all others the moſt proper manure for a garden. Leaves mixed with dung make excellent hot-beds; and I find that beds compounded in this manner, preſerve their heat much longer than when made entirely with dung; and in both caſes, the application of leaves will be a conſiderable ſaving of dung, which is a circumſtance on many accounts agreeable."

Oak-Leaf Galls. Theſe are of ſeveral kinds; the remarkable ſpecies called the *muſhroom gall* is never found on any other vegetable ſubſtance but theſe leaves: and beſide this there are a great number of other kinds.

The double gall of theſe leaves is very ſingular, becauſe the generality of productions of this kind affect only one ſide of a leaf or branch, and grow all one way: whereas this kind of gall extends itſelf both ways, and is ſeen on each ſide of the leaf, in form of two protuberances, oppoſite the one to the other. Theſe are of differently irregular ſhapes, but their natural figure ſeems that of two cones, with broad baſes, and very obtuſe points, though ſometimes they are round, or very nearly ſo.

Theſe make their firſt appearance on the leaf in April, and remain on it till June or longer. They are at firſt green, but afterwards yellowiſh, and are ſofter to the touch than many other of the productions of this kind: they are uſually about the ſize of a large pea, but ſometimes they grow to the bigneſs of a nut. When opened, they are found to be of that kind which are inhabited each by one inſect only, and each contains one cavity. The cavity in this is, however, larger than in any other gall of the ſize, or even in many others of three times the ſize; the ſides of it being very little thicker than the ſubſtance of the leaf.

It is not eaſy to aſcertain the origin of the ſeveral ſpecies of flies which are at times ſeen in this manner to come out of the ſame ſpecies of galls. It ſeems the common courſe of nature, that only one ſpecies of inſect forms one kind of gall; yet it may be, that two or three kinds may give origin to the ſame kind. There is, however, another occaſion of our ſeeing different ſpecies come out of different galls of the ſame kind: and this is the effect of the enemies of the proper inhabitants.

It might appear that the parent fly, when ſhe had formed a gall for the habitation of her worm offspring, had placed it in an impregnable fortreſs; but this is not the caſe; for it frequently happens, that a fly, as ſmall perhaps as that which gave origin to the gall, produces a worm which is of the carnivorous kind, as the other feeds on vegetable juices. This little fly, well knowing that where there is one of theſe protuberances on a leaf, there is a tender and defenceleſs inſect within, pierces the ſides of the gall, and depoſites her egg within it. This, when it hatches into a worm, feeds upon the proper inhabitant; and finally, after devouring it, paſſes into the chryſalis ſtate, and thence appears in the form of its parent fly, and is ſeen making its way out of the gall, in the place of the proper inhabitant.

On opening theſe leaf-galls, which are properly the habitation only of one animal, it is common to find two, the ſtronger preying upon the body of the other, and ſucking its juices as it does thoſe of the leaf: often it is found wholly employed in devouring its unoffending neighbour at once: this is probably the caſe when its time of eating is nearly over: and, in fine, when we find the gall inhabited by only one inſect, or containing only one chryſalis, as it ought in its natural ſtate to do, we are never certain that this is the proper inhabitant, as it may be one of theſe deſtroyers who has eaten up the other, and ſupplied its place. See Aphis, Entomology *Index*.

Oak Saw-duſt is now found to anſwer the purpoſes of tanning, as well, at leaſt, as the bark. See Tanning.

Oak of Jeruſalem. See Chenopodium, Botany *Index*.

OAKHUM, Ockham, or *Oakum*, in ſea-language, denotes the matter of old ropes untwiſted and pulled out into looſe hemp, in order to be uſed in caulking the ſeams, tree nails, and bends of a ſhip, for ſtopping or preventing leaks.

OAKHAMPTON, a town of Devonſhire, which ſends two members to parliament; ſituated in W. Long. 4. 5. N. Lat. 50. 48.

OANNES, a being in Chaldean mythology, repreſented as half a man and half a fiſh. According to Beroſus and other fabulous writers, this monſter was the civilizer of the Chaldeans; to whom he taught a ſyſtem of juriſprudence ſo perfect as to be incapable of improvement. In diſcharging the duties of his office, he ſpent the day on dry land, but retired every night into the ocean or the river. See Mythology, N° 25.

OAR, a long piece of timber, flat at one end and round or ſquare at the other; and which being applied to the ſide of a floating veſſel, ſerves to make it advance upon the water.

That part of the oar which is out of the veſſel, and which enters into the water, is called the *blade*, or *waſh-plat;* and that which is within board is termed the *loom*, whoſe extremity being ſmall enough to be graſped by the rowers, or perſons managing the oars, is called the *handle*.

To puſh the boat or veſſel forwards by means of this inſtrument, the rowers turn their backs forward, and, dipping the blade of the oar in the water, pull the handle forward ſo that the blade at the ſame time may move aft in the water: but ſince the blade cannot be ſo moved, without ſtriking the water, this impulſion is the ſame as if the water were to ſtrike the blade from the ſtern towards the head: the veſſel is therefore neceſſarily moved according to this direction. Hence it follows, that ſhe will advance with the greater rapidity, by as much as the oar ſtrikes the water more forcibly. Thus it is evident, that an oar acts upon the ſide of a boat

boat or veſſel like a lever of the ſecond claſs, whoſe fulcrum is the ſtation upon which the oar reſts on the boat's gunnel. In large veſſels, this ſtation is uſually called the *row-port;* but in lighters and boats it is always termed the *row-lock*.

OARISTUS, or OARISTYS, a term in the Greek poetry, ſignifying a dialogue between a huſband and his wife; ſuch as that in the ſixth book of the Iliad between Hector and Andromache.

Scaliger obſerves, that the oariſtus is not properly any particular little poem, or entire piece of poetry; but always a part of a great one. He adds, that the paſſage now cited in Homer is the only proper oariſtus extant in the ancient poets.

OASIS, the name of a fertile ſpot in the midſt of a ſandy deſert. Many of thoſe ſpots, or *oaſes*, in the African deſerts are remarkable for their fertility.

OAT. See AVENA, BOTANY *Index*.

Mr Bruce gives the following account of the oats which he found growing wild in Arooſſi, a ſmall territory in Abyſſinia, not far from the ſource of the Nile: "Wild oats (ſays he) grow up here ſpontaneouſly to a prodigious height and ſize, capable often of concealing both the horſe and his rider, and ſome of the ſtalks being little elſe than an inch in circumference. They have, when ripe, the appearance of ſmall canes. The inhabitants make no ſort of uſe of this grain in any period of its growth: the uppermoſt thin huſk of it is beautifully variegated with a changeable purple colour; the taſte is perfectly good. I often made the meal into cakes in remembrance of Scotland." Our author informs us, that the Abyſſinians could never be brought to reliſh theſe cakes, which they ſaid were bitter, burnt their ſtomachs, and made them thirſty. He is, however, decidedly of opinion, that the wild oat of Arooſſi is the oat in its original ſtate; and that it has degenerated everywhere in Europe.

OATH, an affirmation or promiſe, accompanied with an invocation of God to witneſs what we ſay; and with an imprecation of his vengeance, or a renunciation of his favour, if what we affirm be falſe, or what we promiſe be not performed (A).

The laws of all civilized ſtates have required the ſecurity of an oath for evidence given in a court of juſtice, and on other occaſions of high importance (B); and the Chriſtian religion utterly prohibits ſwearing, except when oaths are required by legal authority. Indeed no ſerious and reflecting theiſt, whether he admit the truth of revelation or not, can look upon ſwearing on trivial occaſions as any thing elſe than a ſin of a very heinous nature. To call upon that infinite and omnipreſent Being, who created and ſuſtains the univerſe, to witneſs all the impertinence of idle converſation, of which great part is commonly uttered at *random*, betrays a ſpirit ſo profane, that nothing ſhort of experience could make us believe it poſſible for a creature endowed with reaſon and reflection to be habitually guilty of a practice ſo impious. No man can plead in extenuation of this crime, that he is tempted to ſwear by the importunity of any appetite or paſſion implanted in the human breaſt: for the utterance of a profane oath communicates no pleaſure and removes no uneaſineſs: it neither elevates the ſpeaker nor depreſſes the hearer.

Quakers and *Moravians*, ſwayed by theſe conſiderations, and by the ſenſe which they put upon certain texts of Scripture, refuſe to ſwear upon any occaſion, even at the requiſition of a magiſtrate, and in a court of juſtice. Theſe ſcruples are groundleſs; and ſeem to proceed from an incapacity to diſtinguiſh between the proper uſe and abuſe of ſwearing. It is unqueſtionably impious to call upon God to witneſs impertinences, or to uſe his tremendous name as a mere *expletive* in converſation; but it by no means follows, that we may not piouſly call upon him to witneſs truths of importance, or invoke his name with reverence and ſolemnity. No individual could, without groſs profaneneſs, pray for a thouſand times more wealth than he may ever have occaſion to uſe; but it was never thought profane to pray "day by day for our daily bread, for rain from heaven, and fruitful ſeaſons." If it be lawful to aſk of God theſe earthly bleſſings, becauſe he alone can beſtow them; it cannot ſurely be unlawful, where the lives or properties of our

(A) The word *oath* is a corruption of the Saxon *eoth*. It is often in England called a *corporal oath*, becauſe, in the days of popery, the perſon was ſworn over the hoſt or *corpus Chriſti*.

(B) The various oaths required by different nations at different times, and the various forms, &c. of impoſing them, is a ſubject of very conſiderable extent and curioſity: An account of them does not fall within the plan of the preſent article; it would indeed extend it to an undue length; we cannot, however, omit obſerving, what is doubtleſs very remarkable, that the grand impoſtor Mahomet taught the Moſlems, that their oaths might be diſſolved. This wonderful doctrine is contained in the 66th chapter of the Koran; which, to free himſelf from his promiſe and oath to Hafsa his ſpouſe, he pretended was revealed. What the uſe of oaths is in ſuch circumſtances, or what ſecurity they afford for performance, it is difficult to aſcertain.

It is alſo very remarkable, that an oath reſpecting marriages was the cauſe of the firſt divorce at Rome. The circumſtance happened about the year of the city 525, Poſthumius Albinus and Spurius Carvilius being conſuls. The cenſors of this year obſerving the population declining, and imagining it proceeded from intereſted marriages and promiſcuous cohabitation, obliged all the citizens to ſwear, that they would not marry with any other view than that of peopling the republic. It raiſed, however, many ſcruples, and occaſioned many domeſtic ruptures. Among the reſt, one Carvilius Ruga, a man of diſtinction, imagined that he was bound by his oath to divorce his wife, whom he paſſionately loved, becauſe ſhe was barren, which was the firſt inſtance of a divorce at Rome from its foundation, though the marriage laws of the kings allowed it; it afterwards, however, became ſhamefully frequent. This is alſo a ſtriking inſtance of the great attention paid to oaths among the Romans; it is remarked indeed by all writers, that they paid a moſt profound reſpect to them; and on that we know they founded their hopes of ſucceſs in war.

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our neighbours, or the ſecurity of government is concerned, to invoke him with reverence to witneſs the truth of our aſſertions, or the ſincerity of our intentions; becauſe of our truth in many caſes, and of our ſincerity in all, none but he can be the witneſs.

The text of Scripture upon which the Quakers chiefly reſt their argument for the unlawfulneſs of all ſwearing under the goſpel, is our Saviour's prohibition (Mat. v. 34.): "I ſay unto you, ſwear not at all." But whoever ſhall take the trouble of turning over his Bible, and looking at the context, will perceive, that it is only in *ordinary converſation*, and by no means in courts of juſtice, that our Lord prohibits his followers from ſwearing at all. There is no evidence whatever, that ſwearing by *heaven*, by *the earth*, by *Jeruſalem*, or by their own *heads*, was the form of a *judicial oath* in uſe among the Jews. On the contrary, we are told by *Maimonides**, that "if any man ſwear by heaven or by earth, yet this is not an oath;" which ſurely he could not have ſaid, had ſuch been the forms of judicial ſwearing. Indeed they could not have admitted ſuch forms into their courts without expreſsly violating the law of Moſes, who commands them to "Fear the Lord (JEHOVAH) their God, to ſerve him, and to ſwear by his NAME." But the Jews, as every one knows, had ſuch a reverence for the name *Jehovah*, that they would not pronounce it on ſlight occaſions, and therefore could not ſwear by that name in common converſation. Hence, to gratify their propenſity to common ſwearing, they invented ſuch oaths as, by *heaven*, by *earth*, by *Jeruſalem*, by *the life of thy head*, &c. and by this contrivance they thought to avoid the guilt of profaning the name JEHOVAH. Theſe, however, being appeals to inſenſible objects, either had no meaning, or were in fact, as our Saviour juſtly argues, oaths by that God whoſe creatures they were; ſo that the Jew who ſwore them was ſtill guilty of profaneneſs towards the very JEHOVAH whoſe name his ſuperſtition would not permit him to pronounce. But what puts it beyond all doubt that the uſe of judicial oaths is not wholly prohibited in the goſpel, is the conduct of our Saviour himſelf as well as of his apoſtle St Paul. When Jeſus was ſimply *aſked* by the high prieſt, what it was which certain falſe witneſſes teſtified againſt him? we are told by the evangeliſts, that "he held his peace:" but being *adjured* by the living God to declare whether he was the Chriſt, the Son of God, or not, he immediately anſwered the high prieſt, without objecting to the *oath* (for ſuch it was) upon which he was examined. "St Paul, in his Epiſtle to the Romans †, ſays, '*God is my witneſs*, that, without ceaſing, I make mention of you in my prayers;' and to the Corinthians, ſtill more ſtrongly, '*I call God for a record upon my ſoul*, that, to ſpare you, I came not as yet to *Corinth*.' Both theſe expreſſions are of the nature of oaths; and the author of the Epiſtle to the Hebrews ſpeaks of the cuſtom of ſwearing judicially without any mark of cenſure or diſapprobation: 'Men verily ſwear by the greater; and an oath, for confirmation, is to them an end of all ſtrife."

* See *Whitby on the Place.*

† *Paley's Moral Philoſophy.*

But though a nation has an undoubted right to require the ſecurity of an oath upon occaſions of real importance, we do not heſitate to ſay, that, in our opinion, it is ſomething worſe than bad policy to multiply oaths, and to hold out to the people temptations to perjure themſelves. The ſecurity which an oath affords, depends entirely upon the reverence which attaches to it in the mind of him by whom it is given; but that reverence is much weakened by the frequency of oaths, and by the careleſs manner in which they are too often adminiſtered. An excellent moraliſt † obſerves, with truth, that "the levity and frequency with which oaths are adminiſtered, has brought about a general inadvertency to the obligation of them, which both in a religious and political view is much to be lamented; and it merits (continues he) public conſideration, whether the requiring of oaths on ſo many frivolous occaſions, eſpecially in the cuſtoms, and in the qualification for petty offices, has any other effect than to make them cheap in the minds of the people. A pound of tea cannot travel regularly from the ſhip to the conſumer without coſting *half a dozen oaths* at leaſt; and the ſame ſecurity for the due diſcharge of his office, namely that of an oath, is required from a *church warden* and an *archbiſhop*, from a *petty conſtable* and the *chief juſtice* of England. Let the law continue its own ſanctions, if they be thought requiſite; but let it ſpare the ſolemnity of an oath: and where it is neceſſary, from the want of ſomething better to depend upon, to accept a man's own word or own account, let it annex to prevarication penalties proportioned to the public conſequence of the offence."

† *Mr Paley.*

That theſe pernicious conſequences of frequent oaths are not felt only in England, we have the evidence of another reſpectable writer, whoſe acuteneſs well qualified him to obſerve, whilſt his ſtation in ſociety furniſhed him with the beſt opportunities of obſerving, the effects of repeated ſwearing upon the morals of Scotchmen. "Cuſtomhouſe oaths (ſays Lord Kames*) have become ſo familiar among us, as to be ſwallowed without a wry face; and is it certain that bribery and perjury in electing parliament members are not approaching to the ſame cool ſtate? Men creep on to vice by degrees. Perjury, in order to ſupport a friend, has become cuſtomary of late years; witneſs fictitious qualifications in the electors of parliament-men, which are made effectual by perjury: yet ſuch is the degeneracy of the preſent times, that no man is the worſe thought of upon that account. We muſt not flatter ourſelves, that the poiſon will reach no farther: a man who boggles not at perjury to ſerve a friend, will in time become ſuch an adept, as to commit perjury in order to ruin a friend when he becomes an enemy."

* *Sketches of the Hiſtory of Man.*

Beſides the frequency of oaths, we have mentioned the irreverent manner in which they are too often adminiſtered as one of the cauſes which make them cheap in the eſtimation of the people. In this view, the *form* of the oath, and the *ceremonies* with which it is required to be taken, are of conſiderable importance. "The forms of oaths in Chriſtian countries (ſays Mr Paley) are very different; but in none I believe worſe contrived either to convey the meaning or to impreſs the obligation of an oath, than in England. In that country the juror, after repeating the promiſe or affirmation which the oath is intended to confirm, adds, 'ſo help me God;' or more frequently the ſubſtance of the oath is repeated to the juror by the officer or magiſtrate who adminiſters it; adding in the concluſion, 'ſo help you God.' The energy of the ſentence reſides in the

particle

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particle *ſo*; *ſo*, i. e. *hac lege*, ‘ upon condition of my ſpeaking the truth, or performing this promiſe, may God help me, and not otherwiſe.’ The juror, whilſt he hears or repeats the words of the oath, holds his right hand upon a Bible, or other book containing the four goſpels. The concluſion of the oath ſometimes runs, ‘ *ita me Deus adjuvet, et hæc ſancta evangelia*,’ or ‘ ſo help me God, and the contents of this book ;’ which laſt clauſe forms a connexion between the words and action of the juror, which before was wanting. The juror then kiſſes the book.”

This obſcure and elliptical form, the excellent author juſtly obſerves, is ill calculated to impreſs the juror with reverence: and he ſeems to think great preference due to the form of judicial oaths in Scotland. In that country the juror holds up his right hand towards heaven, and ſwears by Almighty God, and as he ſhall anſwer to God at the great day of judgement, “ that he will tell the truth, the whole truth, and nothing but the truth, ſo far as he knows, or it ſhall be aſked of him.” This, if adminiſtered with dignity and reverence, is an oath ſufficiently ſolemn and well calculated to have the proper effect upon the mind of the juror, as it brings immediately into his view the Author of his being, and the awful day of final retribution when every man ſhall receive the things done in his body according to that he hath done, whether it be good or evil. But when the magiſtrate, as is too often the caſe, repeats this ſolemn invocation without riſing from his ſeat at the name of the Supreme Being, and in a tone of careleſſneſs which may convey to the ignorant juror an opinion that he has himſelf no ſerious belief that there ever will be a great day of judgement, the form, however excellent, makes not its full impreſſion.

But let us ſuppoſe the oath to be adminiſtered with the greateſt dignity and reverence, the words of the promiſe itſelf appear to us by no means unexceptionable. In a trial on life and death, we ſhould be glad to know what this oath binds the witneſs to declare. Is he to tell *all that he knows* touching the matter in queſtion ? or only all that ſhall be *aſked* of him ? If he be obliged, in virtue of his oath, to tell all that he knows, the clauſe—“ or it ſhall be aſked of you” is ſuperfluous, and calculated to miſlead. If he be bound to tell nothing more of the truth than what ſhall be aſked of him, the word *or* ſhould be changed into *and;* he ſhould ſwear “ to tell the truth, &c. ſo far as he knows, *and* it ſhall be aſked of him.” The court, we believe, conſiders the witneſs as bound to declare every thing which he knows touching the matter in queſtion. The greater part of witneſſes, on the other hand, conſider themſelves as bound no farther by their oath than to give true anſwers to ſuch queſtions as ſhall be aſked of them. They would do well, however, to remember, that as oaths are deſigned for the ſecurity of the *public*, they muſt be interpreted in the ſenſe in which the public intends them, otherwiſe they afford no ſecurity. But the ſenſe of the public is the law ; and as it belongs to the court to declare what the mind of the law is, the witneſs, who has any doubt concerning the extent of the obligation impoſed on him by the words of this oath, ſhould apply to the court for a ſolution of that doubt, which will be a ſafe guide to him reſpecting the evidence which he is to give. Should the court, in reſolving the doubts of a witneſs, give an opinion concerning the ſenſe of any other part of the oath contrary to what he apprehends to be the deſign of the law in impoſing it, he is bound to diſregard ſuch opinion; becauſe it is only where he himſelf is doubtful that the court has a right to interfere, and becauſe in all moral queſtions men muſt be finally determined by their own judgement and conſcience.

There is one caſe, and but one, in which, whatever ſenſe be put upon the words of the oath, no witneſs is obliged to declare the *whole* truth. It is when ſuch declaration would tend to accuſe himſelf of ſome legal crime ; for as the laws of Scotland and England conſtrain no man to become his own accuſer, they muſt be conſidered as impoſing the oath of teſtimony with this tacit reſervation. “ The exception, however †, muſt be confined to *legal* crimes. A point of honour, of delicacy, or of reputation, may make a witneſs backward to diſcloſe ſome circumſtance with which he is acquainted ; but is no excuſe for concealment, unleſs it could be ſhown, that the law which impoſes the oath, intended to allow this indulgence to ſuch motives. The exception is alſo withdrawn by compact between the magiſtrate and the witneſs, when an accomplice is admitted to give evidence againſt the partners of his crime.” But theſe are a ſort of witneſſes to whom a ſenſible jury will always liſten with a very cautious ear.

† *Paley's Moral Philoſophy.*

Oaths are either *aſſertory* or *promiſſory*. Aſſertory oaths are required both to confirm our veracity in evidence, and to give ſecurity to the public that we *believe* certain propoſitions conceived to be of public importance. An oath in *evidence* binds the juror to declare what he *knows* to be true, and nothing *but* what he knows to be true. An oath required to aſſure the public of our *belief* in the *truth* of any propoſition, cannot, without the guilt of perjury, be taken by any man, who, at the time of ſwearing, has the ſlighteſt doubt whether the propoſition be really true. Such an oath, however, though it unqueſtionably requires the ſincerity of the juror's belief at the time when it is given, cannot oblige him to continue in that belief as long as he may live ; for belief is not in any man's power : it is the neceſſary conſequence of evidence, which *compels* the aſſent of the mind according as it appears to preponderate on the one ſide or on the other. No man, therefore, can be juſtly accuſed of perjury for holding opinions contrary to thoſe which he may formerly have ſworn to believe ; becauſe his belief at the time of emitting his oath may have been the neceſſary reſult of the evidence which then appeared before him ; and his change of opinion may have reſulted with the ſame neceſſity from ſuperior evidence which had been ſince thrown into the oppoſite ſcale, and made it preponderate. On this account, we cannot help thinking, that all aſſertory oaths, except ſuch as are neceſſary to confirm teſtimony reſpecting *facts*, ought either to be aboliſhed or expreſſed with great caution. Of truths intuitively certain or capable of rigid demonſtration, no man of common ſenſe can entertain a doubt ; and therefore the public never requires from individuals the ſolemnity of an oath as an aſſurance of their believing ſuch truths. But with reſpect to the truth of propoſitions which admit of nothing ſuperior to moral evidence on either ſide, a man of the moſt

ſteady

steady virtue may think differently at different periods of his life; and in such cases, the effect of an oath, if it have any effect, can only be either, to shut the man's eyes against the light, or to make his integrity be causelessly questioned by those who shall observe his change of belief.

Promissory oaths cannot, without the guilt of perjury, be given by him, who, at the time of swearing, knows that it will not be in his power to fulfil the promise, or who does not seriously intend to fulfil it. A promissory oath cannot, without great guilt, be given by any man, who at the time of swearing believes the object of the promise to be in itself unlawful; for if he seriously mean to fulfil his oath, he calls upon Almighty God to witness his intention to commit a crime. Promissory oaths give to the public greater security than a simple promise; because the juror having the thoughts of God and of religion more upon his mind at the one time than at the other, offends with a higher hand, and in more open contempt of the divine power, knowledge, and justice, when he violates an oath, than when he breaks a promise. Yet it is certain that promissory oaths, though more solemn and sacred, cannot be binding, when the promise without an oath would not be so in an inferior degree; for the several cases of which, see PROMISE and ALLEGIANCE.

Coronation OATH. See KING.

OATHLAW, the name of a parish in Angus, about two miles from Forfar, chiefly remarkable for the remains of a Roman camp called *Battle-dykes* (vulgarly *Black-dykes*), which is about a mile west of the church.

OBADIAH, or the *Prophecy of* OBADIAH, a canonical book of the Old Testament, which is contained in one single chapter; and is partly an invective against the cruelty of the Edomites, who mocked and derided the children of Israel as they passed into captivity; and with other enemies, their confederates, invaded and oppressed those strangers, and divided the spoil amongst themselves; and partly a prediction of the deliverance of Israel, and of the victory and triumph of the whole church over her enemies.

OBADIAH, the prophet, is believed to have been the same with the governor of Ahab's house, mentioned in the first book of Kings, (xviii. 3, &c.) who hid and fed the hundred prophets whom Jezebel would have destroyed; and some say, that he was that Obadiah whom Josiah made overseer of the works of the temple, (2 Chron. xxxiv. 12.). The truth is, that when he lived or prophesied is wholly uncertain: though most writers make him cotemporary with Hosea, Amos, and Joel.

OBADIAH, a valiant man of David's army, who came to join him in the wilderness, with several others of the tribe of Gad, (1 Chron. xii. 9.).

This was also the name of one of those whom King Jehoshaphat sent into the cities of Judah to instruct the people in their religion, (2 Chron. xvii. 7.). It was also the name of one of the principal men of Judah, who signed the covenant that Nehemiah renewed with the Lord, (Nehem. x. 5.).

OBED-EDOM, son of Jeduthun, a Levite, (1 Chr. xvi. 38.) and father of Shemaiah, Jehozabad, Joah, Sacar, Nathaneel, Ammiel, Issachar, and Peulthai. He had a numerous family, says the Scripture, (1 Chron. xxvi. 4.) because the Lord blessed him; and this is the occasion of the blessing. When David transferred the ark of the covenant to the city of Jerusalem, Uzzah having rashly laid hands on the ark, which he thought to be in danger of falling, was smitten of God, and died upon the spot. David, terrified at this accident, durst not remove the ark into the place he had provided for it in his own house, but set it up in the house of Obed-edom, which was near the place where Uzzah had been struck dead. But the presence of the ark not only created no temporal misfortune to the family of this Levite, but, on the contrary, the Lord heaped upon him all sorts of blessings; which encouraged David some months after to remove it to the place he had appointed for it. Afterwards Obed-edom and his sons were assigned to be keepers of the doors of the temple, (1 Chron. xv. 18, 21.). In the second book of Samuel, (vi. 10.) Obed-edom is called the Gittite, probably because he was of Gathrimmon, a city of the Levites beyond Jordan, (Josh. xxi. 24, 25.).

OBELISK, in *Architecture*, a truncated, quadrangular, and slender pyramid, raised as an ornament, and frequently charged either with inscriptions or hieroglyphics.

Obelisks appear to be of very great antiquity, and to have been first raised to transmit to posterity precepts of philosophy, which were cut in hieroglyphical characters: afterwards they were used to immortalize the great actions of heroes, and the memory of persons beloved. The first obelisk mentioned in history was that of Ramases king of Egypt, in the time of the Trojan war, which was 40 cubits high. Phius, another king of Egypt, raised one of 55 cubits; and Ptolemy Philadelphus, another of 88 cubits, in memory of Arsinoë. Augustus erected one at Rome in the Campus Martius, which served to mark the hours on a horizontal dial, drawn on the pavement. They were called by the Egyptian priests the *fingers of the sun*, because they were made in Egypt also to serve as styles or gnomons to mark the hours on the ground. The Arabs still call them *Pharaoh's needles;* whence the Italians call them *aguglia*, and the French *aiguilles*.

The famous obelisks called the *devil's arrows*, now reduced to three, the fourth having been taken down in the last century, stand about half a mile from the town of Borough-Bridge to the south-west, in three fields, separated by a lane, 200 feet asunder, nearly on high ground sloping every way. Mr Drake urges many arguments for their Roman antiquity, and plainly proves them to be natural and brought from Plumpton quarries about five miles off, or from Ickly 16 miles off. The cross in the town, 12 feet high, is of the same kind of stone. The eastermost or highest is 22 feet and a half high by 4 broad, and $14\frac{1}{2}$ in girth; the second $21\frac{1}{2}$ by $55\frac{1}{2}$; the third $16\frac{1}{2}$ by 84. Stukeley's measures differ. The flutings are cut in the stone but not through: the tallest stands alone, and leans to the south. Plot and Stukeley affirm them to be British monuments, originally hewn square. Dr Gale supposed that they were Mercuries, which have lost their heads and inscriptions; but in a MS. note in his Antoninus, he acknowledges that he was misinformed, and that there was no cavity to receive a bust.

On the north side of Penrith, in the churchyard, are two square obelisks, of a single stone each, 11 or 12 feet high,

high, about 12 inches diameter, and 12 by 8 at the sides, the highest about 18 inches diameter, with something like a transverse piece to each, and mortised into round base. They are 14 feet asunder, and between them is a grave enclosed between four semicircular stones of the unequal lengths of five, six, and four and a half, and two feet high, having on the outsides rude carving, and the tops notched. This is called the *Giant's grave*, and ascribed to Sir Ewan Cæsarius, who is said to have been as tall as one of the columns, and capable of stretching his arms from one to the other; to have destroyed robbers and wild boars in Englewood forest; and to have had a hermitage hereabouts called *Sir Hugh's parlour*; but the conjectures respecting them are extremely various and contradictory. A little to the west of these is a stone called the *Giant's Thumb*, six feet high, 14 inches at the base contracted to 10, which is no more than a rude cross, such as is at Longtown in Cumberland and elsewhere; the circle of the cross 18 inches diameter.

Near the town of Forres in the north of Scotland there is a very fine obelisk, 22 feet in height, known by the name of the *Forres pillar*, or *Sweno's stone*. See Forres.

M. Pouchard, in the memoirs of the Academy of Inscriptions, gives a curious account of some celebrated Egyptian obelisks. See Gentleman's Magazine for June 1748.

OBJECT, in *Philosophy*, something apprehended or presented to the mind by sensation or imagination. See Metaphysics, Part I. Chap. I. Sect. II.

Object-Glass of a Telescope, or *Microscope*, the glass placed at the end of the tube which is next the object. See Optics and Microscope.

OBJECTION, something urged to overthrow a position, or a difficulty raised against an allegation or proposition of a person we are disputing with.

OBJECTIVE, is used in the schools, in speaking of a thing which exists no otherwise than as an object known. The existence of such a thing is said to be objective.

OBIT, (Lat.) signifies a funeral solemnity, or office for the dead, most commonly performed when the corpse lies in the church uninterred: Also the anniversary office, (2 Cro. 51 Dyer 313). The anniversary of any person's death was called the *obit*; and to observe such day with prayers and alms, or other commemoration, was the keeping of the obit. In religious houses they had a register, wherein they entered the obits or obitual days of their founders and benefactors; which was thence termed the *obituary*. The tenure of obit or chantry lands is taken away and extinct by 1 Edw. VI. c. 14. and 15 Car. II. c. 9.

OBLATE, flattened or shortened; as an oblate spheroid, having its axis shorter than its middle diameter; being formed by the rotation of an ellipse about the shorter axis. The earth, whose polar diameter is shorter than the equatorial, is an oblate spheroid.

OBLATI, in church history, were secular persons, who devoted themselves and their estates to some monastery, into which they were admitted as a kind of lay brothers. The form of their admission was putting the bell ropes of the church round their necks, as a mark of servitude. They wore a religious habit, but different from that of the monks.

OBLIGATION, in general, denotes any act whereby a person becomes bound to another to do something; as to pay a sum of money, be surety, or the like.

Obligations are of three kinds, viz. natural, civil, and mixed. Natural obligations are entirely founded on natural equity; civil obligations on civil authority alone, without any foundation in natural equity; and mixed obligations are those which, being founded on natural equity, are farther enforced by civil authority.

In a legal sense, obligation signifies a bond, wherein is contained a penalty, with a condition annexed, for the payment of money, &c. The difference between it and a bill is, that the latter is generally without a penalty or condition, though it may be made obligatory: and obligations are sometimes by matter of record, as statutes and recognizances. See the article Bond.

Moral Obligation. See Moral Philosophy, N° 58, &c.

OBLIQUE, in *Geometry*, something aslant, or that deviates from the perpendicular. Thus an oblique angle is either an acute or obtuse one, i. e. any angle except a right one.

Oblique Cases, in *Grammar*, are all the cases except the nominative. See Grammar.

Oblique Ascension, is that point of the equinoctial which rises with the centre of the sun, or star, or any other point of the heavens, in an oblique sphere.

Oblique Circle, in the stereographic projection, is any circle that is oblique to the plane of projection.

Oblique Descension, that point of the equinoctial which sets with the centre of the sun, or star, or any other point of the heavens, in an oblique sphere.

Oblique Line, that which, falling on another line, makes oblique angles with it, viz. one acute, and the other obtuse.

Oblique Planes, in *Dialling*, are those which decline from the zenith, or incline towards the horizon. See Dial.

Oblique Sailing, in *Navigation*, is when a ship sails upon some rhumb between the four cardinal points, making an oblique angle with the meridian; in which case she continually changes both latitude and longitude. See Navigation, Chap. VIII.

OBLIQUUS, in *Anatomy*, a name given to several muscles, particularly in the head, eyes, and abdomen. See Anatomy, *Table of the Muscles*.

OBLONG, in general, denotes a figure that is longer than broad; such is a parallelogram.

OBOLARIA, a genus of plants belonging to the didynamia class; and in the natural method ranking under the 40th order, *Personatæ*. See Botany *Index*.

OBOLUS, an ancient silver money of Athens, the sixth part of a drachma; worth somewhat more than a penny-farthing sterling.—The word comes from the Greek ὀβολος, or ὀβελος, "spit, or broach;" either because it bore such an impression; or because, according to Eustathius, it was in form thereof. But those now in the cabinets of the antiquaries are round.

Obolus, in *Medicine*, is used for a weight of ten grains, or half a scruple.

OBOTH, an encampment of the Hebrews in the wilderness. From Punon they went to Oboth, and from Oboth to Ije-abarim, (Numb. xxi. 10. xxxiii. 43.).

Ptolemy ſpeaks of a city called Oboda, or Eboda, in Arabia Petræa, which is the ſame as Oboth. Pliny and the geographer Stephanus mention it alſo. Stephanus makes it belong to the Nabathæans, and Pliny to the Helmodeans, a people of Arabia. It was at Oboth that they worſhipped the god Obodus, which Tertullian joins with Duſares, another god or king of this country.

OBREPTITIOUS, an appellation given to letters patent, or other inſtruments, obtained of a ſuperior by ſurpriſe, or by concealing from him the truth.

OBSCURE, ſomething that is dark and reflects little light in material objects, or that is not clear and intelligible in the objects of the intellect.

OBSECRATION, in *Rhetoric*, a figure whereby the orator implores the aſſiſtance of God or man.

OBSEQUIES, the ſame with funeral ſolemnities. See FUNERAL.

OBSERVATION, among navigators, ſignifies the taking the ſun's or the ſtars meridian altitude, in order thereby to find the latitude.

OBSERVATORY, a place deſtined for obſerving the heavenly bodies; being generally a building erected on ſome eminence, covered with a terrace for making aſtronomical obſervations.

The more celebrated obſervatories are, 1. The Greenwich obſervatory, built in 1676, by order of Charles II. at the ſolicitation of Sir Jonas Moore and Sir Chriſtopher Wren; and furniſhed with the moſt accurate inſtruments; particularly a noble ſextant of ſeven feet radius, with teleſcopic ſights.

2. The Paris obſervatory, built by the order of Louis XIV. in the fauxbourg St Jacques.

It is a very ſingular, and a very magnificent building, the deſign of Monſieur Perault: it is 80 feet high; and has a terrace at the top.

The difference in longitude between this and the Greenwich obſervatory is 2° 20′.

In it is a cave or cellar, of 170 feet deſcent, for experiments that are to be made far from the ſun, &c. particularly ſuch as relate to congelations, refrigerations, indurations, conſervations, &c.

3. Tycho Brahe's obſervatory, which was in the little iſland Ween, or Scarlet Iſland, between the coaſts of Schonen and Zealand in the Baltic. It was erected and furniſhed with inſtruments at his own expence, and called by him *Uraniburg*. Here he ſpent twenty years in obſerving the ſtars; the reſult is his catalogue.

4. Pekin obſervatory. Father Le Compte deſcribes a very magnificent obſervatory, erected and furniſhed by the late emperor of China, in his capital, at the interceſſion of ſome Jeſuit miſſionaries, principally Father Verbeiſt, whom he made his chief obſerver. The inſtruments are exceedingly large; but the diviſion leſs accurate, and the contrivance in ſome reſpects leſs commodious, than that of the Europeans. The chief are, An armillary zodiacal ſphere of ſix feet diameter; an equinoctial ſphere of ſix feet diameter; an azimuthal horizon of ſix feet diameter; a large quadrant ſix feet radius; a ſextant eight feet radius; and a celeſtial globe ſix feet diameter.

Obſervatories, as they are very uſeful, and indeed abſolutely neceſſary for aſtronomers, ſo they have become far more common than they were. There is a very excellent one now at Oxford, built by the truſtees of Dr Radcliffe, at the expence of nearly 30,000l. At Cambridge there is as yet no public obſervatory. Over the great gate of Trinity college, indeed, there is one which is called *Sir Iſaac Newton's*, becauſe this great philoſopher had uſed it; but it is gone to decay. It were well if the univerſity would repair and preſerve it in memory of that truly great man. In St John's, too, there is a ſmall one. The late ingenious Mr Cotes had uſed to give lectures in Sir Iſaac Newton's on experimental philoſophy. In Scotland there is an obſervatory at Glaſgow belonging to the univerſity: there is one erected on the Calton hill at Edinburgh; but it is in very bad repair, (ſee EDINBURGH); and there is an excellent one at Dublin.

5. Bramins obſervatory at Benares. Of this Sir Robert Barker gives the following account, (Phil. Tranſ. vol. lxvii. p. 598.). "Benares in the Eaſt Indies, one of the principal ſeminaries of the Bramins or prieſts of the original Gentoos of Hindoſtan, continues ſtill to be the place of reſort of that ſect of people; and there are many public charities, hoſpitals, and pagodas, where ſome thouſands of them now reſide. Having frequently heard that the ancient Bramins had a knowledge of aſtronomy, and being confirmed in this by their information of an approaching eclipſe both of the ſun and moon, I made inquiry, when at that place in the year 1772, among the principal Bramins, to endeavour to get ſome information relative to the manner in which they were acquainted of an approaching eclipſe. The moſt intelligent that I could meet with, however, gave me but little ſatisfaction. I was told, that theſe matters were confined to a few, who were in poſſeſſion of certain books and records; ſome containing the myſteries of their religion; and others the tables of aſtronomical obſervations, written in the Shanſcrit language, which few underſtood but themſelves: that they would take me to a place which had been conſtructed for the purpoſe of making ſuch obſervations as I was inquiring after, and from whence they ſuppoſed the learned Bramins made theirs. I was then conducted to an ancient building of ſtone, the lower part of which, in its preſent ſituation, was converted into a ſtable for horſes, and a receptacle for lumber; but by the number of court-yards and apartments, it appeared that it muſt once have been an edifice for the uſe of ſome public body of people. We entered this building, and went up a ſtaircaſe to the top of a part of it, near to the river Ganges, that led to a large terrace, where, to my ſurpriſe and ſatisfaction, I ſaw a number of inſtruments yet remaining, in the greateſt preſervation, ſtupendouſly large, immoveable from the ſpot, and built of ſtone, ſome of them being upwards of 20 feet in height; and although they are ſaid to have been erected 200 years ago, the graduations and diviſions on the ſeveral arcs appeared as well cut, and as accurately divided, as if they had been the performance of a modern artiſt. The execution in the conſtruction of theſe inſtruments exhibited a mathematical exactneſs in the fixing, bearing, fitting of the ſeveral parts, in the neceſſary and ſufficient ſupports to the very large ſtones that compoſed them, and in the joining and faſtening each into the other by means of lead and iron.

Plate CCCLXX.

"The ſituation of the two large quadrants of the inſtrument marked A in the plate, whoſe radius is nine feet two inches, by their being at right angles with a gnomon

gnomon at twenty-five degrees elevation, are thrown into fuch an oblique fituation as to render them the moft difficult, not only to conftruct of fuch a magnitude, but to fecure in their pofition for fo long a period, and affords a ftriking inftance of the ability of the architect in their conftruction: for by the fhadow of the gnomon thrown on the quadrants, they do not appear to have altered in the leaft from their original pofition; and fo true is the line of the gnomon, that, by applying the eye to a fmall iron ring of an inch diameter at one end, the fight is carried through three others of the fame dimenfion, to the extremity at the other end, diftant 38 feet 8 inches, without obftruction; fuch is the firmnefs and art with which this inftrument has been executed. This performance is the more wonderful and extraordinary, when compared with the works of the artificers of Hindoftan at this day, who are not under the immediate direction of an European mechanic; but arts appear to have declined equally with fcience in the eaft.

"Lieutenant Colonel Archibald Campbell, at that time chief engineer in the Eaft India Company's fervice at Bengal, made a perfpective drawing of the whole of the apparatus that could be brought within his eye at one view; but I lament he could not reprefent fome very large quadrants, whofe radii were about 20 feet, they being on the fide from whence he took his drawing. Their defcription, however, is, that they are exact quarters of circles of different radii, the largeft of which I judged to be 20 feet, conftructed very exactly on the fides of ftone walls, built perpendicular, and fituated, I fuppofe, in the meridian of the place: a brafs pin is fixed at the centre or angle of the quadrant, from whence, the Bramin informed me, they ftretched a wire to the circumference when an obfervation was to be made; from which, it occurred to me, the obferver muft have moved his eye up or down the circumference, by means of a ladder or fome fuch contrivance, to raife and lower himfelf, until he had difcovered the altitude of any of the heavenly bodies in their paffage over the meridian, fo expreffed on the arcs of thefe quadrants: thefe arcs were very exactly divided into nine large fections; each of which again into ten, making ninety leffer divifions or degrees; and thofe alfo into twenty, expreffing three minutes each, of about two-tenths of an inch afunder; fo that it is probable they had fome method of dividing even thefe into more minute divifions at the time of obfervation.

"My time would only permit me to take down the particular dimenfions of the moft capital inftrument, or the greater equinoctial fun dial, reprefented by figure A, which appears to be an inftrument to exprefs folar time by the fhadow of a gnomon upon two quadrants, one fituated to the eaft, and the other to the weft of it; and indeed the chief part of their inftruments at this place appear to be conftructed for the fame purpofe, except the quadrants, and a brafs inftrument that will be defcribed hereafter.

"Figure B is another inftrument for the purpofe of determining the exact hour of the day by the fhadow of a gnomon, which ftands perpendicular to, and in the centre of, a flat circular ftone, fupported in an oblique fituation by means of four upright ftones and a crofs piece; fo that the fhadow of the gnomon, which is a perpendicular iron rod, is thrown upon the divifion of the circle defcribed on the face of the flat circular ftone.

"Figure C is a brafs circle, about two feet diameter, moving vertically upon two pivots between two ftone pillars, having an index or hand turning round horizontally on the centre of this circle, which is divided into 360 parts; but there are no counter divifions on the index to fubdivide thofe on the circle. This inftrument appears to be made for taking the angle of a ftar at fetting or rifing, or for taking the azimuth or amplitude of the fun at rifing or fetting.

"The ufe of the inftrument, figure D, I was at a lofs to account for. It confifts of two circular walls; the outer of which is about forty feet diameter, and eight feet high; the wall within about half that height, and appears intended for a place to ftand on to obferve the divifions on the upper circle of the outer wall, rather than for any other purpofe; and yet both circles are divided into 360 degrees, each degree being fubdivided into twenty leffer divifions, the fame as the quadrants. There is a door-way to pafs into the inner circle, and a pillar in the centre, of the fame height with the lower circle, having a hole in it, being the centre of both circles, and feems to be a focket for an iron rod to be placed perpendicular into it. The divifions on thefe, as well as all the other inftruments, will bear a nice examination with a pair of compaffes.

"Figure E is a fmaller equinoctial fun dial, conftructed upon the fame principle as the large one A.

"I cannot quit this fubject without obferving, that the Bramins, without the affiftance of optical glaffes, had neverthelefs an advantage unexperienced by the obfervers of the more northern climates. The ferenity and clearnefs of the atmofphere in the nighttime in the Eaft Indies, except at the feafons of the monfoons or periodical winds changing, is difficult to exprefs to thofe who have not feen it, becaufe we have nothing in comparifon to form our ideas upon: it is clear to perfection, a total quietude fubfifts, fcarcely a cloud to be feen, and the light of the heavens, by the numerous appearance of the ftars, affords a profpect both of wonder and contemplation.

"This obfervatory at Benares is faid to have been built by the order of the emperor Ackbar: for as this wife prince endeavoured to improve the arts, fo he wifhed alfo to recover the fciences of Hindoftan, and therefore directed that three fuch places fhould be erected; one at Delhi, another at Agra, and the third at Benares."

OBSIDIANUS LAPIS, or OBSIDIAN, a mineral fubftance. See MINERALOGY *Index*.

OBSIDIONALIS, an epithet applied by the Romans to a fort of crown. See the article CROWN.

OBSTETRICS, or the OBSTETRIC ART, the fame with MIDWIFERY.

OBSTRUCTION, in *Medicine*, fuch an obturation of the veffels as prevents the circulation of the fluids, whether of the found and vital, or of the morbid and peccant kind, through them.

OBTURATOR. See ANATOMY, *Table of the Mufcles*.

OBTUSE, fignifies blunt, dull, &c. in oppofition to acute or fharp. Thus we fay, obtufe angle, obtufe-angled triangle, &c.

Oby ‖ Occupancy.

OBY, or OB, a large and famous river of Asiatic Russia, which issues from the Altin lake (called by the Russians *Teleskoi Osero*), in latitude 52 degrees, and longitude 103 degrees 30 minutes. Its name signifies *Great*; and accordingly in Russia it is often styled the *Great River*. The Calmucks and Tartars call it *Umar*. Its stream is very large and smooth, its current being usually slow; and it is in general between two and three hundred fathoms broad; though in some places it is much wider. It affords plenty of fish, and is navigable almost to the lake from which it springs. After a long winding course through a vast tract of land, in which it forms several islands, it empties itself in latitude 67 degrees, and longitude 86 degrees, into a bay, which, extending near 400 miles farther, joins the Icy sea, in latitude 73. 30. and longitude 90. The springs from which this river rises, are not very copious; but it receives in its course the waters of a great number of considerable streams. Of these, the Tom and the Irtis are the most considerable: the Tom falls into it in latitude 58. and the Irtis in latitude 61. and longitude 86. The exact course of this river was unknown till the country was surveyed by the Russians; who have given us tolerable maps of it and of all Siberia. The Oby forms the boundary between Europe and Asia, and its course is upwards of 2000 miles in length.

OCCIDENT, in *Geography*, the westward quarter of the horizon; or that part of the horizon where the ecliptic, or the sun therein, descends into the lower hemisphere; in contradistinction to *orient*. Hence we use the word *occidental* for any thing belonging to the west; as occidental bezoar, occidental pearl, &c.

OCCIDENT *Estival*, that point of the horizon where the sun sets at midwinter, when entering the sign Capricorn.

OCCIDENT *Equinoctial*, that point of the horizon where the sun sets, when he crosses the equinoctial, or enters the sign Aries or Libra.

OCCIPITAL, in *Anatomy*, a term applied to the parts of the occiput, or back part of the skull.

OCCULT, something hidden, secret, or invisible. The occult sciences are magic, necromancy, cabbala, &c. Occult qualities, in philosophy, were those qualities of body or spirit which baffled the investigation of philosophers, and for which they were unable to give any reason; unwilling, however, to acknowledge their ignorance, they deceived themselves and the vulgar by an empty title, calling what they did not know *occult*.

OCCULT, in *Geometry*, is used for a line that is scarce perceivable, drawn with the point of the compasses or a leaden pencil. These lines are used in several operations, as the raising of plans, designs of building, pieces of perspective, &c. They are to be effaced when the work is finished.

OCCULTATION, in *Astronomy*, the time a star or planet is hid from our sight, by the interposition of the body of the moon or some other planet.

Blackst. Comment.

OCCUPANCY, in *Law*, is the taking possession of those things which before belonged to nobody. This is the true ground and foundation of all PROPERTY, or of holding those things in severalty, which by the law of nature, unqualified by that of society, were common to all mankind. But, when once it was agreed that every thing capable of ownership should have an owner, natural reason suggested, that he who could first declare his intention of appropriating any thing to his use, and, in consequence of such his intention, actually took it into possession, should thereby gain the absolute property of it; according to that rule of the law of nations, recognized by the laws of Rome, *Quod nullius est, id ratione naturali occupanti conceditur*.

Occupancy.

This right of occupancy, so far as it concerns real property, hath been confined by the laws of England within a very narrow compass; and was extended only to a single instance; namely, where a man was tenant *pour autre vie*, or had an estate granted to himself only (without mentioning his heirs) for the life of another man, and died during the life of *cestuy que vie*, or him by whose life it was holden: in this case he that could first enter on the land, might lawfully retain the possession so long as *cestuy que vie* lived, by right of occupancy.

This seems to have been recurring to first principles, and calling in the law of nature to ascertain the property of the land, when left without a legal owner. For it did not revert to the granter, who had parted with all his interest, so long as *cestuy que vie* lived; it did not escheat to the lord of the fee; for all escheats must be of the absolute entire fee, and not of any particular estate carved out of it, much less of so minute a remnant as this: it did not belong to the grantee; for he was dead: it did not descend to his heirs; for there were no words of inheritance in the grant: nor could it vest in his executors; for no executors could succeed to a freehold. Belonging therefore to nobody, like the *hæreditas jacens* of the Romans, the law left it open to be seized and appropriated by the first person that could enter upon it, during the life of *cestuy que vie*, under the name of an occupant. But there was no right of occupancy allowed, where the king had the reversion of the lands: for the reversioner hath an equal right with any other man to enter upon the vacant possession; and where the king's title and a subject's interfere, the king's shall always be preferred. Against the king therefore there could be no prior occupant, because *nullum tempus occurrit regi*. And, even in the case of a subject, had the estate *pour autre vie* granted to a man *and his heirs* during the life of *cestuy que vie*, there the heir might, and still may, enter and hold possession, and is called in law a *special occupant*; as having a special exclusive right, by the terms of the original grant, to enter upon and occupy this *hæreditas jacens*, during the residue of the estate granted: though some have thought him so called with no very great propriety; and that such estate is rather a descendible freehold. But the title of *common occupancy* is now reduced almost to nothing by two statutes; the one, 29 Car. II. c. 3. which enacts, that where there is no special occupant, in whom the estate may vest, the tenant *pour autre vie* may devise it by will, or it shall go to the executors, and be assets in their hands for payment of debts: the other that of 14 Geo. II. c. 20. which enacts, that it shall vest not only in the executors, but, in case the tenant dies intestate, in the administrators also; and go in course of a distribution like a chattel interest.

By these two statutes the title of *common occupancy* is utterly extinct and abolished: though that of *special occupancy*, by the heir at law, continues to this day; such heir

Occupancy. heir being held to succeed to the ancestor's estate, not by descent, for then he must take an estate of inheritance, but as an occupant, specially marked out and appointed by the original grant. The doctrine of common occupancy may, however, be usefully remembered on the following account, amongst others: That, as by the common law no occupancy could be of incorporeal hereditaments, as of rents, tithes, advowsons, commons, or the like, (because, with respect to them, there could be no actual entry made, or corporal seisin had; and therefore by the death of the grantee *pour autre vie* a grant of such hereditaments was entirely determined): so now, it is apprehended, notwithstanding those statutes, such grant would be determined likewise; and the hereditaments could not be deviseable, nor vest in the executors, nor go in a course of distribution. For the statutes must not be construed so as to create any new estate, or to keep that alive which by the common law was determined, and thereby to defeat the granter's reversion; but merely to dispose of an interest in being, to which by law there was no owner, and which therefore was left open to the first occupant. When there is a residue left, the statutes give it to the executors, &c. instead of the first occupant; but they will not create a residue on purpose to give it to the executors. They only mean to provide an appointed instead of a casual, a certain instead of an uncertain, owner, of lands which before were nobody's; and thereby to supply this *casus omissus*, and render the disposition of the law in all respects entirely uniform; this being the only instance wherein a title to a real estate could ever be acquired by occupancy.

For there can be no other case devised, wherein there is not some owner of the land appointed by the law. In the case of a sole corporation, as a parson of a church, when he dies or resigns, though there be no *actual* owner of the land till a successor be appointed, yet there is a *legal*, *potential*, ownership, subsisting in contemplation of law; and when the successor is appointed, his appointment shall have a retrospect and relation backwards, so as to entitle him to all the profits from the instant that the vacancy commenced. And, in all other instances, when the tenant dies intestate, and no other owner of the lands is to be found in the common course of descents, there the law vests an ownership in the king, or in the subordinate lord of the fee, by escheat.

So also, in some cases, where the laws of other nations give a right by occupancy, as in lands newly created, by the rising of an island in a river, or by the alluvion or dereliction of the sea; in these instances, the law of England assigns them an immediate owner. For Bracton tells us, that if an island arise in the *middle* of a *river*, it belongs in common to those who have lands on each side thereof; but if it be nearer to one bank than the other, it belongs only to him who is proprietor of the nearest shore: which is agreeable to, and probably copied from, the civil law. Yet this seems only to be reasonable, where the soil of the river is equally divided between the owners of the opposite shores: for if the whole soil is the freehold of any one man, as it must be whenever a several fishery is claimed, there it seems just (and so is the usual practice) that the islets, or little islands, arising in any part of the river, shall be the property of him who owneth the piscary and the soil. However, in case a new island rise in the *sea*, though the civil law gives it to the first occupant, yet our's gives it to the king. And as to lands gained from the sea; either by *alluvion*, by the washing up of sand and earth, so as in time to make *terra firma*; or by *dereliction*, as when the sea shrinks back below the usual water mark; in these cases the law is held to be, that if this gain be by little and little, by small and imperceptible degrees, it shall go to the owner of the land adjoining. For *de minimis non curat lex*: and, besides, these owners being often losers by the breaking in of the sea, or at charges to keep it out, this possible gain is therefore a reciprocal consideration for such possible charge or loss. But if the alluvion or dereliction be sudden and considerable, in this case it belongs to the king: for, as the king is lord of the sea, and so owner of the soil while it is covered with water, it is but reasonable he should have the soil when the water has left it dry. So that the quantity of ground gained, and the time during which it is gained, are what make it either the king's or the subject's property. In the same manner, if a river, running between two lordships, by degrees gains upon the one, and thereby leaves the other dry; the owner who loses his ground thus imperceptibly has no remedy: but if the course of the river be changed by a sudden and violent flood, or other hasty means, and thereby a man loses his grounds, he shall have what the river has left in any other place as recompense for this sudden loss. And this law of alluvions and derelictions, with regard to *rivers*, is nearly the same in the imperial law; from whence indeed those our determinations seem to have been drawn and adopted: but we ourselves, as islanders, have applied them to *marine* increases; and have given our sovereign the prerogative he enjoys, as well upon the particular reasons before mentioned, as upon this other general ground of prerogative, which was formerly remarked, that whatever hath no other owner is vested by law in the king. See PREROGATIVE.

Occupancy ‖ Ocean.

OCCUPANT, in *Law*, the person that first seizes or gets possession of a thing.

OCCUPATION, in a legal sense, is taken for use or tenure: as in deeds it is frequently said, that such lands are, or were lately, in the tenure or occupation of such a person.—It is likewise used for a trade or mystery.

OCCUPIERS *of* WALLING, a term used in the salt-works for the persons who are the sworn officers that allot in particular places what quantity of salt is to be made, that the markets may not be overstocked, and see that all is carried fairly and equally between the lord and the tenant.

OCEAN, that huge mass of salt waters which encompasses all parts of the globe, and by means of which, in the present improved state of navigation, an easy intercourse subsists between places the most distant.

The ocean is distinguished into three grand divisions. 1. The Atlantic ocean, which divides Europe and Africa from America, which is generally about 3000 miles wide. 2. The Pacific ocean, or South sea, which divides America from Asia, and is generally about 10,000 miles over. And, 3. The Indian ocean, which separates the East Indies from Africa: which is 3000 miles over. The other seas, which are called *oceans*, are only parts or branches of these, and usually receive their names from the countries they border upon.

For

For the faltnefs, tides, &c. of the ocean, fee the articles SEA, TIDES, &c.

OCEANIDES, in fabulous hiftory, fea nymphs, daughters of Oceanus, from whom they received their name, and of the goddefs Tethys or Thetis. They were 3000 according to Apollodorus, who mentions the names of feven of them; Afia, Styx, Electra, Donis, Eurynome, Amphitrite, and Metis. Hefiod fpeaks of the eldeft of them, which he reckons 41, Pitho, Admete, Prynno, Ianthe, Rhodia, Hippo, Callirhoe, Urania, Clymene, Idyia, Pafithoe, Clythia, Zeuxo, Galuxaure, Plexaure, Perfeis, Pluto, Thoe, Polydora, Melobofis, Dione, Cerceis, Xanthe, Acafta, Ianira, Telestho, Europa, Meneftho, Petræa, Eudora, Calypfo, Tyche, Ocyroe, Crifia, Amphiro, with thofe mentioned by Apollodorus, except Amphitrite. Hyginus mentions 16, whofe names are almoft all different from thofe of Apollodorus and Hefiod; which difference proceeds from the mutilation of the original text. The Oceanides, like the reft of the inferior deities, were honoured with libations and facrifices. Prayers were offered to them, and they were entreated to protect failors from ftorms and dangerous tempefts. The Argonauts, before they proceeded to their expedition, made an offering of flour, honey, and oil, on the fea fhore, to all the deities of the fea, and facrificed bulls to them, and entreated their protection. When the facrifice was made on the fea fhore, the blood of the victim was received in a veffel; but when it was in open fea, they permitted the blood to run down into the waters. When the fea was calm, they generally offered a lamb or a young pig; but if it was agitated by the winds and rough, a black bull was deemed the moft acceptable victim.

OCEANUS, in Pagan mythology, the fon of Cœlus and Terra, the hufband of Thetis, and the father of the rivers and fountains, called *Oceanides*. The ancients called him the *Father of all things*, imagining that he was produced by Humidity, which, according to Thales, was the firft principle from which every thing was produced. Homer reprefents Juno vifiting him at the remoteft limits of the earth, and acknowledging him and Thetis as the parents of the gods. He was reprefented with a bull's head, as an emblem of the rage and bellowing of the ocean when agitated by a ftorm.

According to Homer, he was the father even of all the gods, and on that account he received frequent vifits from them. He is often, indeed almoft always, reprefented as an old man with a long flowing beard, and fitting upon the waves of the fea. He often holds a pike in his hand, while fhips under fail appear at a diftance, or a fea monfter ftands near him. Oceanus prefided over every part of the fea, and even the rivers were fubjected to his power. The ancients were fuperftitious in their worfhip of him, and revered with great folemnity a deity to whofe care they intrufted themfelves when going on any voyage.

OCEIA, a woman who prefided over the facred rites of Vefta for 57 years with the greateft fanctity. She died in the reign of Tiberius, and the daughter of Domitius fucceeded her.

OCELLUS *the* LUCANIAN, an ancient Greek philofopher of the fchool of Pythagoras, who lived before Plato. His work περι του Παντος, or "The Univerfe," is the only piece of his which is come down entire to us; and was written originally in the Doric dialect, but was tranflated by another hand into the Attic. William Chriftian, and after him Lewis Nogarola, tranflated this work into Latin; and we have feveral editions of it, both in Greek and Latin.

OCELOT, the Mexican cat. See FELIS, MAMMALIA *Index*.

OCHLOCRACY, that form of government wherein the populace have the chief adminiftration of affairs.

OCHNA, a genus of plants belonging to the polyandria clafs; and in the natural method ranking with thofe of which the order is doubtful. See BOTANY *Index*.

OCHRE, in *Natural Hiftory*, a mineral fubftance compofed of oxide and carbonate of iron, and clay. See ORES OF IRON, MINERALOGY *Index*.

OCHROMA, a genus of plants belonging to the monadelphia clafs; and in the natural method ranking under the 37th order, *Columniferæ*. See BOTANY *Index*.

OCHUS, a king of Perfia, fon of Artaxerxes. He was cruel and avaricious; and in order to ftrengthen himfelf on his throne, he murdered all his brothers and fifters. His fubjects revolted; but he reduced them to obedience, and added Egypt to his other dominions. Bagoas, his favourite eunuch, poifoned him for the infults he had offered to Apis the god of the Egyptians; and he gave his flefh to be eaten by cats, and made handles for knives with his bones. It feems to be not a little remarkable, that all thofe monfters who difgraced humanity by their crimes, and funk themfelves below the level of brutes, have met with condign punifhment; and this in general feems true, whether we refer to ancient or modern times.—A man of Cyzicus, who was killed by the Argonauts.—A prince of Perfia, who refufed to vifit his native country for fear of giving all the women each a piece of gold.—A river of India or of Bactriana.—A king of Perfia: He exchanged this name for that of Darius Nothus. See PERSIA.

OCRA, a vifcous vegetable fubftance well known in the Weft Indies, where it is ufed to thicken foup, particularly that kind called pepper pot, as well as for other purpofes.

OCRISIA, in fabulous hiftory, the wife of Corniculus, was one of the attendants of Tanaquil the wife of Tarquinius Prifcus. As fhe was throwing into the flames, for offerings, fome of the meats that were ferved on the table of Tarquin, fhe fuddenly faw, as is reported, in the fire, what Ovid calls *obfcæni forma virilis*. She informed the queen of it; and when by her command fhe had approached near it, fhe conceived a fon who was named Servius Tullius, and was educated in the king's family. He afterwards fucceeded to the vacant throne. Some fuppofe that Vulcan had affumed that form which was prefented to the eyes of Ocrifia, and that this god was the father of the fixth king of Rome.

OCTAETERIS, a cycle or term of eight years, in the Grecian chronology, at the conclufion of which three entire lunar months were added. This cycle was in ufe till Meton's invention of the golden number or cycle of 19 years.

OCTAGON, or OCTOGON, in *Geometry*, is a figure of eight fides and angles; and this, when all the fides and

and angles are equal, is called a *regular octagon*, or one that may be inscribed in a circle.

OCTAGON, in *Fortification*, denotes a place that has eight bastions. See FORTIFICATION.

OCTAHEDRON, or OCTAEDRON, in *Geometry*, one of the five regular bodies, consisting of eight equal and equilateral triangles.

OCTANDRIA (ὀκτω "eight," and ἀνηρ a "man or husband,") the 8th class in Linnæus's sexual system; consisting of plants which are furnished with eight stamina. See BOTANY *Index*.

OCTANT, the eighth part of a circle.

OCTANT, or OCTILE, in *Astronomy*, that aspect of two planets, wherein they are distant an eighth part of a circle, or 45° from each other.

OCTAPLA, in matters of sacred literature, denotes a Polyglot Bible, consisting of eight columns, and as many different versions of the sacred text; viz. the original Hebrew both in Hebrew and Greek characters, Greek versions, &c.

OCTATEUCH, an appellation given to the eight first books of the Old Testament.

OCTAVE, in *Music*. See INTERVAL.

OCTAVIA, daughter of Caius Octavius and sister to Augustus Cæsar. See the following article. She was one of the most illustrious ladies of ancient Rome; her virtues and her beauty were equally conspicuous.—Prideaux says she was much handsomer than Cleopatra. She married Claudius Marcellus, and after his death M. Antony. Her marriage with Antony was a political match, to reconcile her brother and him together. Antony proved for some time attentive to her: but when he had seen Cleopatra, he neglected and despised her: and when she attempted to withdraw him from this illegal amour by going to meet him at Athens, she was rebuked and totally banished from his presence. This affront was highly resented by her brother; and though Octavia endeavoured to pacify him by palliating Antony's behaviour, yet he resolved to revenge her cause by arms. After the battle of Actium and the death of Antony, Octavia, forgetful of her own injuries, took into her house all the children of her husband, and treated them with extraordinary tenderness. Marcellus, her son by her first husband, was married to a niece of Augustus, and openly intended as a successor to his uncle. His sudden death plunged all the family into the greatest grief. Virgil, whom Augustus patronized, undertook of himself to pay a melancholy tribute to the memory of a young man whom Rome had looked upon as her future father and patron. He was desired to repeat his composition in the presence of the emperor and his sister. Octavia burst into tears even when the poet began; but when he mentioned *Tu Marcellus eris*, she swooned away. This tender and pathetic encomium upon the merit and the virtues of young Marcellus she liberally rewarded; and Virgil received 10,000 sesterces, according to some 78l. 2s. 6d. for every one of the verses. Octavia had two daughters by Antony, Antonia Major and Antonia Minor.—The elder married L. Domitius Ahenobarbus, by whom she had Cn. Domitius, who was the father of the emperor Nero by Agrippina the daughter of Germanicus. Antonia Minor, who was as virtuous and as beautiful as her mother, married Drusus the son of Tiberius, by whom she had Germanicus, and Claudius who reigned before Nero. The death of Marcellus constantly preyed upon the mind of Octavia, who died of grief or melancholy, about 11 years before the Christian era. Her brother paid great regard to her memory, and pronounced her funeral oration himself. The Roman people also showed their regard to her virtues, by wishing to pay her divine honours.—A daughter of the emperor Claudius by Messalina. She was betrothed to Silanus, but by the intrigues of Agrippina, she was married to the emperor Nero in the 16th year of her age. She was soon after divorced under pretence of barrenness; and the emperor married Poppæa, who exercised her enmity upon Octavia by procuring her to be banished into Campania. She was afterwards recalled by the people; but Poppæa, who was determined on her ruin, caused her again to be banished to an island, where she was ordered to kill herself by opening her veins. Her head was cut off and carried to Poppæa.

OCTAVIANUS, or OCTAVIUS CÆSAR, was nephew of Julius Cæsar the dictator, being the son of Accia his sister by Octavius a senator, and afterwards became the second emperor of Rome. He was born in the year of the city 691, during the consulship of Cicero. His uncle Julius Cæsar adopted him, and left him the greatest part of his fortune. When he was but 20 years of age, he was raised to the consulship. His youth and inexperience were ridiculed by his enemies; notwithstanding which obstacle, his prudence and valour raised his consequence. He made war against his opponents on pretence of avenging the assassination of his uncle. He engaged in five civil wars with great success, viz. The wars of Mutina, Perusia, Philippi, Sicily, and Actium: the first and last of which were against M. Antony; the second against L. Antony, brother of the triumvir; the third was against Brutus and Cassius; and the fourth against Sext. Pompey, son of Pompey the Great. He united his forces with Antony's at the battle of Philippi; and had he not been supported by the activity and bravery of his colleague, he would doubtless have been totally ruined in that engagement. In this triumvirate with Antony and Lepidus, he obtained the western parts of the Roman empire; and, like his other colleagues, more firmly to establish his power, he proscribed his enemies and cut them off. The triumvirate lasted for 10 years. He had given his sister Octavia in marriage to Antony, to make their alliance more lasting; but when Cleopatra had charmed this unfortunate man, Octavia was repudiated. Augustus immediately took up arms to avenge the wrongs of his sister; but perhaps more eager to remove a man whose power and existence kept him in continual fear and constant dependence. Both parties met at Actium to decide the fate of Rome. Antony was supported by all the power of the east, and Augustus by Italy. Cleopatra fled from the battle with 60 ships; and her flight ruined the interest of Antony, who followed her into Egypt. The conqueror soon after went into Egypt likewise, besieged Alexandria, and honoured with a magnificent funeral his unfortunate colleague and the celebrated queen, whom the fear of being led in the victor's triumph at Rome had driven to commit suicide. After he had established peace all over the world, he shut the gates of the temple of Janus, A. U. C. 753. He was twice determined to lay down the supreme power

and

immediately after the victory obtained over Antony, and on account of his ill health; but his two faithful friends Mecænas and Agrippa dissuaded him, and contended, that if he did he would leave it to be the prey of the most powerful, and expose himself to the greatest dangers. He died at Nola in the 76th year of his age, after he had held the sovereign power for 57 years.—He was an active emperor, and consulted the good of the Romans with the greatest anxiety and care. He visited all the provinces except Africa and Sardinia, and his consummate prudence and experience occasioned many salutary laws. He is, however, accused of licentiousness and adultery; but the goodness of his heart, the fidelity of his friendship, and the many good qualities which the poets whom he patronized have perhaps truly celebrated, made some, though in the eye of strict religion and true morality but little, amends for his natural foibles. He was ambitious of being esteemed handsome; and as he was publicly reported to be the son of Apollo according to his mother's declaration, he wished his flatterers to represent him with the figure and attributes of that god. Like Apollo, his eyes were clear, and he affected to have it thought that they possessed some divine irradiation, and was well pleased if, when he fixed his eyes upon any body, they held down their eyes as if overcome by the glaring brightness of the sun. He distinguished himself by his learning; he was a complete master of the Greek language, and wrote some tragedies, besides memoirs of his life and other works, which are now lost. He married four times; but he was unhappy in all these connexions; and his only daughter Julia disgraced herself and her father by the debauchery and licentiousness of her manners. He recommended at his death his adopted son Tiberius as his successor. He left his fortune partly to him and to Drusus, and made donations to the army and Roman people. The title of Augustus was conferred upon him by the senate after the battle of Actium and the final destruction of the Roman republic. The title continued afterwards, being given to his successors in the empire. Virgil is said to have written his Æneid at the desire of Augustus, whom he represents under the amiable and perfect character of Æneas. The name of Octavius was very common at Rome; it was the name of a variety of men of very considerable rank.

OCTOBER, in *Chronology*, the eighth month of Romulus's year, which the name implies; but tenth in the kalendar of Numa, Julius Cæsar, &c. The senate gave this month the name *Faustinus*, in compliment to Faustina, the wife of the emperor Antoninus; Commodus would have it called *Invictus;* and Domitian named it *Domitianus;* but in spite of all these attempts it still retains its original name. This month was sacred to Mars, and under his protection.

OCTOBER Equus, a horse annually sacrificed to Mars in the month of October, either because the horse is a warlike animal, or to punish him for the taking of Troy. A race was run with chariots, drawn by two horses, previous to the sacrifices, and he that ran quickest was adjudged to be the victim.

OCTOSTYLE, in the ancient architecture, is the face of an edifice adorned with eight columns.

OCULUS, the EYE, in *Anatomy*. See there, N° 145.

OCYMOPHYLLON, a name given by Buxbaum to a new genus of plants, the characters of which are these: The flower is of the stamineous kind, having no petals; this stands upon the embryo fruit, which afterwards becomes an oblong quadrangular seed-vessel, divided into four cells, and containing roundish and very small seeds; its leaves are like those of the common ocymum or basil, whence its name; and its place of growth is in damp marshes. Boccone has described it under the improper name of *glaux*, calling it the *great, green-flowered, marsh glaux*.

OCYMUM, BASIL; a genus of plants belonging to the didynamia class; and in the natural method ranking under the 42d order, *Verticillatæ*. See BOTANY *Index*.

OCZAKOW, or OCZAKOFF, a town of Turkey in Europe, and capital of a sangiack of the same name, inhabited by Tartars. During a late war, here was a Turkish garrison of 20,000 men. However, it was taken by the Russians in 1737, and all those that resisted were put to the sword. The Russians themselves lost 18,000 men in the assault. The Turks returned the same year with 70,000 men to retake it; but were obliged to retire, after the loss of 20,000. In 1738, the Russians withdrew their garrison, and demolished the fortifications. It is seated on the river Bog, to the west of the Nieper, or rather where they both unite and fall into the Black sea. It is 42 miles south-west of Bialagrod, and 190 north by east of Constantinople. It has been lately a subject of great contest between the Russians and Turks. The affair is fresh in our readers memories; but the following more particular account of the place, will not, we trust, be unacceptable to our readers.—It is called by the Turks *Dzain Crimenda*, is seated at the influx of the Nieper into the Black sea, 120 miles from Bender, to the south-east. The river is here above a mile broad. Hither the Turkish galleys retire which guard the mouth of the river, to prevent the Cossacks from pirating upon the Black sea. Here is no port, but good anchorage. It is defended by a castle, surrounded with walls 25 feet high; those of the town are much lower. There are about 2000 people at Oczakow. Below the castle are two towns or suburbs, situated on the declivity of a hill, which on the other side has nothing but precipices. To the south of these towns is another small castle, where is some artillery to prevent vessels from coming up the river. Here is also a tower, in which are always some Turks upon the watch to discover from afar any of the Cossacks at sea, and give notice of them to the galleys by a signal. The city is inhabited by Tartars, though garrisoned by Turks. E. Long. 30. 50. N. Lat. 46. 50.

ODA, in the Turkish seraglio, signifies a class, order, or chamber. The grand signior's pages are divided into five classes or chambers. The first, which is the lowest in dignity, is called the *great oda*, from the greater number of persons that compose it; these are the juniors, who are taught to read, write, and speak the languages. The second is called the *little oda*, where from the age of 14 or 15 years, till about 20, they are trained up to arms, and the study of all the polite learning the Turks are acquainted with. The third chamber, called *kilar oda*, consists of 200 pages, who, besides their other exercises, are under the command of the kilardgi-bachi, and serve in the pantry and fruitery.

fruitery. The fourth consists only of 24, who are under the command of the khazineda-bachi, and have charge of the treasure in the grand signior's apartment, which they never enter with clothes that have pockets. The fifth is called *kas oda* or *privy-chamber;* and is composed of only 40 pages, who attend in the prince's chamber. Every night eight of these pages keep guard in the grand signior's bedchamber while he sleeps: they take care that the light, which is constantly kept in the room, does not glare in his eyes, lest it should awake him: and if they find him disturbed with troublesome dreams, they cause him to be awakened by one of their agas.

ODA *Bachi*, or *Oddabassi*, an officer in the Turkish soldiery, equivalent to a serjeant or corporal among us. The common soldiers and janizaries, called *oldachis*, after having served a certain number of years, are always preferred and made biquelairs; and of biquelairs in time become odobachis, i. e. corporals of companies, or chiefs of certain divisions, whose number is not fixed; being sometimes ten, and sometimes twenty.

Their pay is six doubles per month; and they are distinguished by a large felt, a foot broad and above a foot long, hanging on the back, with two long ostrich feathers.

ODDLY-ODD. A number is said to be oddly-odd, when an odd number measures it by an odd number. So 15 is a number oddly-odd, because the odd number 3 measures it by the odd number 5.

ODE, in *Poetry*, a song, or composition proper to be sung. See POETRY.

ODED, a prophet of the Lord, who being at Samaria, when the Israelites of the ten tribes returned from the war, with their king Pekah, together with 200,000 of the people of Judah captives, he went out to meet them, and said, "You have seen that the Lord God of your fathers was in wrath against Judah; he has therefore delivered them into your hands, and you have slain them inhumanly, so that your cruelty has ascended up into heaven; and more than this, you would make slaves of the children of Judah, who are your brethren, and would add this sin to the many others you have committed: therefore, hear the counsel that I give you; send back these captives, lest the Lord should pour out his fury upon you." Oded having done speaking, some of the chiefs of Samaria seconded him, and by their remonstrances prevailed with the Israelites to set the captives at liberty (2 Chron. xxviii.). See AHAZ.

The enlargement of the captives being obtained, the principal men of Samaria took care of them, gave them clothes and food and other necessary assistance. After which they furnished them with horses, because the greatest part of them were so tired and exhausted that they were not able to walk. Thus they conducted them to Jericho, which was in the confines of the land of Judah. This is all that is come to our knowledge concerning the prophet Oded.

ODENSEE, the capital of the isle of Funen, a place of such high antiquity, that some Danish writers derive its foundation and name from Odin the god and hero of the Gothic nations. "Its name certainly occurs (says Mr Coxe) in the earliest ages of the Danish history; and it was a town of great note long before Copenhagen existed. Odensee stands upon a small river, not navigable, and about two miles from the bay of Stegestrand. Many of the houses are ancient, bearing dates about the middle of the 16th century; but part is newly built: it contains about 5200 inhabitants, who carry on some commerce, exporting chiefly grain and leather; the latter is much esteemed, and its goodness is supposed to arise from a certain property in the river water, in which it is soaked for tanning. The Danish cavalry are supplied from thence with the greatest part of their leathern accoutrements.

"Odensee is the seat of a bishop, which was founded by Harold Blaatand in 980, and is the richest in Denmark next to Copenhagen. It has a school, endowed by the celebrated Margaret of Valdemar, in which a certain number of scholars, from six to 16 years of age, are instructed gratis: they live and board in the town, and each receives a yearly pension; other scholarships have been also founded by private persons. The whole number amounted to 70. There is also a gymnasium, instituted by Christian IV. for the admission of students at the age of 16. The seminary was still further improved by the liberality of Holberg the Danish historian, who protected letters with the same zeal with which he cultivated them. It is now greatly fallen from its former flourishing state, containing, when I passed through the town, only eight students. The cathedral is a large old brick building, which has nothing remarkable except some costly monuments of a private Danish family. The church, which formerly belonged to the convent of Recolets, contains the sepulchre of John king of Denmark, and of his son Christian II." E. Long. 10. 27. N. Lat. 55. 28.

ODENATUS, a celebrated prince of Palmyra, who very early inured himself to bear fatigues, and by hunting leopards and wild beasts, accustomed himself to the labours of a military life. He was a faithful friend to the Romans; and when Aurelian had been taken prisoner by Sapor king of Persia, Odenatus warmly interested himself in his cause, and solicited his release, by writing to the conqueror, and by sending him presents. The king of Persia was offended at this liberty of Odenatus, he tore the letter, and ordered the presents that were offered to be thrown into a river, and in order to punish Odenatus, who had the impudence, as he called it, to pay homage to so great a monarch as himself, he commanded him to appear before him, on pain of being devoted to instant destruction with all his family, if he dared to refuse. Odenatus despised this haughty summons of Sapor, and opposed force by force. He obtained some considerable advantages over the troops of the Persian king, and took his wife prisoner, with a great and rich booty. These services were observed with gratitude by the Romans; and Gallienus, the then emperor, named Odenatus as his colleague on the throne, and gave the title of *Augustus* to his children, and to his wife the celebrated Zenobia. Odenatus invested with new power, resolved to signalize himself more conspicuously by conquering the barbarians of the north: but his exulting was of short duration: he perished by the dagger of one of his own relations, whom he had slightly offended at a domestic entertainment.—He died at Emessa about the 267th year of the Christian era. Zenobia succeeded to his titles and honours.

ODER, a river of Germany, which has its source near

near a town of the same name in Silesia, and on the confines of Moravia. It runs north through that province, and then into the marche of Brandenburg and Pomerania, where it forms a large lake, afterwards falling into the Baltic sea by three mouths; between which lie the islands Usedom and Wolin. It passes by several towns; as Ratibor, Oppelen, Breslau, Glogau and Grossen, in Silesia; Francfort, Lebus, and Custrin, in Brandenburg; and Gartz, Stetin, Cammin, Wallin, Usedom, and Wolgast, in Pomerania.

ODEUM, in Grecian antiquity, a music theatre built by Pericles; the inside of which was filled with seats and ranges of pillars, and on the outside the roof descended shelving downwards from a point in the centre, with many bendings, in imitation of the king of Persia's pavilion. Here the musical prizes were contended for; and here also, according to Aristophanes was a tribunal.

ODIN (see FREA), in *Mythology*, called also in the dialect of the Anglo-Saxons, *Woden* or *Wodan*, a name given by the ancient Scythians to their supreme god, and assumed, about 70 years before the Christian era, by Sigge, a Scythian prince, who conquered the northern nations, made great changes in their government, manners, religion, and enjoyed great honours, and had even divine honours paid him. According to the account given of this conqueror by Snorro, the ancient historian of Norway, and his commentator Torfæus, Odin was a Scythian, who withdrew himself, with many others in his train, by flight, from the vengeance of the Romans, under the conduct of Pompey; and having officiated as a priest in his own country, he assumed the direction of the religious worship, as well as the civil government, of the nations which he conquered. Having subdued Denmark, Sweden, and Norway, he retired to Sweden, where he died. There is nothing certain in this account; but it is probable, that the god, whose prophet or priest this Scythian pretended to be, was named *Odin*, and that the ignorance of succeeding ages confounded the deity with his priest, composing out of the attributes of the one, and the history of the other, the character of the northern conqueror. He deluded the people by his enchantments and skill in magic: having cut off the head of one Mimer, who in his lifetime was in great reputation for wisdom, he caused it to be embalmed, and persuaded the Scandinavians that he had restored it to the use of speech; and he caused it to pronounce whatever oracles he wanted. The Icelandic chronicles represent Odin as the most eloquent and persuasive of men; they ascribe to him the introduction of the art of poetry among the Scandinavians, and likewise the invention of the Runic characters. He had also the address to persuade his followers, that he could run over the world in the twinkling of an eye; that he had the direction of the air and tempests; that he could transform himself into all sorts of shapes, could raise the dead, could foretel things to come, deprive his enemies, by enchantment, of health and vigour, and discover all the treasures concealed in the earth. They add, that by his tender and melodious airs, he could make the plains and mountains open and expand with delight; and that the ghosts, thus attracted, would leave their infernal caverns, and stand motionless about him. Nor was he less dreadful and furious in battle; changing himself into the shape of a bear, a wild bull, or a lion, and amidst ranks of enemies committing the most horrible devastation, without receiving any wound himself.

Dr Henry gives this account of him: "Odin is believed to have been the name of the one true God among the first colonies who came from the east and peopled Germany and Scandinavia, and among their posterity for several ages. But at length a mighty conqueror, the leader of a new army of adventurers from the east, overrun the north of Europe, erected a great empire, assumed the name of *Odin*, and claimed the honours which had been formerly paid to that deity. From thenceforward this deified mortal, under the name of *Odin* or *Wodin*, became the chief object of the idolatrous worship of the Saxons and Danes in this island, as well as of many other nations. Having been a mighty and successful warrior, he was believed to be the god of war, who gave victory, and revived courage in the conflict. Having civilized, in some measure, the countries which he conquered, and introduced arts formerly unknown, he was also worshipped as the god of arts and artists. In a word, to this Odin his deluded worshippers impiously ascribed all the attributes which belong only to the true God: to him they built magnificent temples, offered many sacrifices, and consecrated the fourth day of the week, which is still called by his name in England and in all the other countries where he was formerly worshipped. Notwithstanding all this, the founders of all the kingdoms of the Anglo-Saxon heptarchy pretended to be descended from Wodin, and some of them at the distance only of a few generations." *Henry's Hist. of Britain, vol. ii.*

ODIN'S Fire. We have this account of it in Gough's Camden. "In Evie parish, in the Orkneys, near the sea, are some rocks, which frequently in the night appear on fire; and the church of St Michael there was often seen full of lights, called fires sent by Odin to guard their tombs, but now ceased. This may be a meteor, or some inflammable matter on the cliffs, as at Charmouth, Dorset."

ODINUS, a celebrated hero of antiquity, who flourished about 70 years before the Christian era, in the northern parts of ancient Germany, or in the modern kingdom of Denmark. He was at the same time a priest, a soldier, a poet, a monarch, and a victor. He imposed upon the credulity of his superstitious countrymen, and made them believe that he could raise the dead, and that he was acquainted with futurity. When he had extended his power, and increased his fame by conquest and by artifice, he determined to die in a different way from other men. He assembled his friends, and with the sharp point of a lance he made in his body nine different wounds in the form of a circle; and when expiring he declared that he was going to Scythia, where he should become an immortal god. He added, that he would prepare bliss and felicity for those of his countrymen who lived a virtuous life, who fought with bravery, and who died like heroes in the field of battle. These injunctions had the wished-for effect: his countrymen superstitiously believed him, and constantly recommended themselves to his protection when they engaged in battle; and they entreated him to receive the souls of such as fell in war.

De-

De ODIO et Atia. See *Falſe IMPRISONMENT.*

The writ *de odio et atia* was anciently uſed to be directed to the ſheriff, commanding him to inquire whether a priſoner charged with murder was committed upon juſt cauſe of ſuſpicion, or merely *propter odium et atiam*, for hatred and ill will; and if upon the inquiſition due cauſe of ſuſpicion did not then appear, then there iſſued another writ for the ſheriff to admit him to bail. This writ, according to Bracton, ought not to be denied to any man; it being expreſsly ordered to be made out *gratis*, without any denial, by *magna charta*, c. 26. and ſtatute Weſtm. 2. 13 Edw. I. c. 29. But the ſtatute of Gloceſter, 6 Edw. I. c. 9. reſtrained it in the caſe of killing by miſadventure or ſelf defence, and the ſtatute 28 Edw. III. c. 9. aboliſhed it in all caſes whatſoever: but as the ſtat. 42 Ed. III. c. 1. repealed all ſtatutes then in being, contrary to the great charter, Sir Edward Coke is of opinion that the writ *de odio et atia* was thereby revived. See *HABEAS Corpus.*

ODO, ST, ſecond abbot of Cluny in France, was illuſtrious for learning and piety in the 10th century. The ſanctity of his life contributed greatly to enlarge the congregation of Cluny; and he was ſo eſteemed, that popes, biſhops, and ſecular princes, uſually choſe him the arbiter of their diſputes. He died about the year 942, and his works are printed in the Bibliotheque of Cluny.

ODO Cantianus, ſo called as being a native of Kent in England, was a Benedictine monk in the 12th century, in which order his learning and eloquence raiſed him to the dignity of prior and abbot. Archbiſhop Becket was his friend; and his panegyric was made by John of Saliſbury. He compoſed Commentaries on the Pentateuch, and the Second Book of Kings; Moral Reflections on the Pſalms; treatiſes entitled, *De Onere Philiſtini; De Moribus Eccleſiaſticis; De Vitiis et Virtutibus Animæ*, &c.

ODOACER, according to Ennodius, was meanly born, and only a private man in the guards of the emperor Auguſtulus, when (A. D. 476, under the conſulſhip of Baſilicus and Armatus) the barbarians choſe him for their leader. The barbarians thought, as they often defended Italy, they had a right at leaſt to part of it; but upon demanding it they were refuſed, and the conſequence was a revolt. Odoacer is ſaid to have been a man of uncommon parts, capable alike of commanding an army or governing a ſtate. Having left his own country when he was very young, to ſerve in Italy, as he was of a ſtature remarkably tall, he was admitted among the emperor's guards, and continued in that ſtation till the above year; when, putting himſelf at the head of the barbarians in the Roman pay, who, though of different nations, had unanimouſly choſen him for their leader, he marched againſt Oreſtes, and his ſon Auguſtulus, who ſtill refuſed to ſhare any of the lands in Italy. The Romans were inferior both in numbers and valour, and were eaſily conquered: Oreſtes was ordered to be ſlain; but the emperor Auguſtulus was ſpared, and, though ſtripped of his dignity, was treated with humanity, and allowed a liberal ſum for his own ſupport and for that of his relations. Odoacer was proclaimed king of Italy; but aſſumed neither the purple nor any other mark of imperial conſequence. He was afterwards defeated and ſlain by Theodoric the Oſtrogoth. See OSTROGOTH.

ODOMETER, an inſtrument for meaſuring the diſtance paſſed over in travelling. See PEDOMETER.

ODONTALGIA, the TOOTHACH. See MEDICINE, Nº 210.

ODONTOIDE, in *Anatomy*, an appellation given to the proceſs of the ſecond vertebra of the neck, from its reſemblance to a tooth.

ODOROUS, or ODORIFEROUS, appellations given to whatever ſmells ſtrongly, whether they be fetid or agreeable; but chiefly to things whoſe ſmell is briſk and pleaſant.

ODYSSEY, the name of an epic poem compoſed by Homer, which, when compared with the Iliad, exhibits its author as the ſetting ſun, whoſe grandeur remains without the heat of his meridian beams.

The poet's deſign in the Odyſſey was to paint the miſeries of a kingdom in the abſence of its ſupreme governor, and the evil conſequences reſulting from a diſregard of law, and of that ſubordination without which ſociety cannot exiſt. With this view he ſets before his countrymen the adventures of a prince who had been obliged to forſake his native country, and to head an army of his ſubjects in a foreign expedition; and he artfully contrives, without interrupting the narrative, to make the reader acquainted with the ſtate of the country in the abſence of its ſovereign. The chief having glorioufly finiſhed the enterpriſe in which he was engaged, was returning with his army; but in ſpite of all his eagerneſs to be at home, he was detained on the way by tempeſts for ſeveral years, and caſt upon ſeveral countries differing from each other in manners and in government. In theſe dangers his companions, not ſtrictly obeying his orders, periſh through their own fault. In the mean time the grandees of his country abuſe the freedom which his abſence gave them; conſume his eſtate; conſpire to deſtroy his ſon; endeavour to compel his queen to accept one of them for her huſband; and indulge themſelves in every ſpecies of violence, from a perſuaſion that he would never return. In this they were diſappointed. He returns; and diſcovering himſelf only to his ſon and ſome others who had maintained their allegiance, he is an eye witneſs of the inſolence of his enemies, puniſhes them according to their deſerts, and reſtores to his iſland that tranquillity and repoſe to which it had been a ſtranger during the many years of his abſence.

Such is the fable of the Odyſſey, in which there is no opportunity of diſplaying that vigour and ſublimity which characterize the Iliad. "It deſcends from the dignity of gods and heroes †, and warlike achievements; but in recompenſe we have more pleaſing pictures of ancient manners. Inſtead of that ferocity which reigns in the other poem, this preſents us with the moſt amiable images of hoſpitality and humanity; entertains us with many a wonderful adventure; and inſtructs us by ſuch a conſtant vein of morality and virtue which runs through the poem," ſometimes in precepts, and always in the conduct of the hero, that we ſhould not wonder if Greece, which gave the appellation of *wiſe* to men who uttered ſingle ſentences of truth, had given to Homer the title of *the father of virtue*, for introducing into his work ſuch

† *Blair's Lectures.*

a number of moral maxims. As a poem, however, the Odyſſey has its faults. The laſt twelve books are tedious and languid; and we are diſappointed by the calm behaviour of Penelope upon the diſcovery of her long loſt huſband.

OECONOMICS, the art of managing the affairs of a family or community; and hence the perſon who takes care of the revenues and other affairs of churches, monaſteries, and the like, is termed *œconomus*.

OECONOMISTS, a ſect of French philoſophers, who obtained this name in conſequence of directing their attention and reſearches to objects of political economy, and in particular to the improvement of the departments of finance. The views of thoſe philoſophers, among whom are reckoned the celebrated names of Voltaire, d'Alembert, Diderot, and Condorcet, have been variouſly repreſented; by ſome as directly hoſtile to all regular government, and by others as unfriendly to religion.

OECONOMY, denotes the prudent conduct, or diſcreet and frugal management, whether of a man's own eſtate or that of another.

Animal OECONOMY, comprehends the various operations of nature in the generation, nutrition and preſervation of animals*. The doctrine of the animal economy is nearly connected with phyſiology, which explains the operation and action of the ſeveral parts of the human body, their uſe, &c. See ANATOMY and PHYSIOLOGY.

* See *Generation*, *Nutrition*, &c.

OECUMENICAL, ſignifies the ſame with *general* or *univerſal;* as, œcumenical council, biſhop, &c.

OEDEMA, or PHLEGMATIC TUMOUR, in *Medicine* and *Surgery*, a ſort of tumour attended with paleneſs and cold, yielding little reſiſtance, retaining the print of the finger when preſſed with it, and accompanied with little or no pain.

This tumour obtains no certain ſituation in any particular part of the body, ſince the head, eyelids, hands, and ſometimes part, ſometimes the whole body, is afflicted with it. When the laſt mentioned is the caſe, the patient is ſaid to be troubled with a cachexy, leucophlegmatia, or dropſy. But if any particular part is more ſubject to this diſorder than another, it is certainly the feet, which are at that time called *ſwelled* or *œdematous feet*.

OEDERA, in *Botany*, a genus of plants belonging to the ſyngeneſia claſs. See BOTANY *Index*.

OEDIPUS, the unfortunate king of Thebes, whoſe hiſtory is partly fabulous, flouriſhed about 1266 B. C. It is ſaid he was given by his father to a ſhepherd, who was ordered to put him to death, in order to prevent the misfortunes with which he was threatened by an oracle. But the ſhepherd, being unwilling to kill him with his own hands, tied him by the feet to a tree, that he might be devoured by wild beaſts. The infant was however found in this ſituation by another ſhepherd named *Phorbas*, who carried him to Polybus king of Corinth; where the queen, having no children, educated him with as much care as if he had been her own ſon. When he was grown up, he was informed that he was not the ſon of Polybus; on which, by order of the oracle, he went to ſeek for his father in Phocis; but ſcarce was he arrived in that country, when he met his father on the road, and killed him without knowing him. A ſhort time after, having delivered the country from the monſter called the *Sphinx*, he married Jocaſta, without knowing that ſhe was his mother, and had four children by her; but afterwards, being informed of his inceſt, he quitted the throne, and, thinking himſelf unworthy of the light, put out his eyes. Eteocles and Polynices, who were celebrated among the Greeks, were born of this inceſtuous marriage.

OEGWA, a town on the Gold coaſt of Africa, ſituated, according to Artus, on the brow of an eminence, raiſing itſelf by a gentle aſcent to a conſiderable height, and defended by rocks, againſt which the waves beat with the utmoſt violence, the noiſe of which is heard at a great diſtance.

Barbot affirms, that Oegwa contains above 500 houſes disjoined by narrow crooked ſtreets; and that from the ſea it has the appearance of an amphitheatre. Des Marchias reduces the number of houſes to 200, in the centre of which ſtands a large ſquare building, the repoſitory of their gold duſt and other commodities. The houſes are built of earth and clay, but convenient, and well furniſhed with chairs, ſtools, mats, carpets, earthen pots, and even looking glaſſes, which laſt they purchaſe from the Europeans. No part of the coaſt is better provided with all kinds of eatables, which are ſent in from the adjacent cantons, and ſold in public markets. Every thing is bought and ſold with gold duſt, which is the ſtandard of all other commodities, and brought hither in great abundance from all quarters of Fetu, Abrambo, Aſſiento, and Mandingo. The gold is ſold by weight, and the quantity determined by nice ſcales, made in the country before it was frequented by the Europeans: a proof that thoſe negroes are not wholly ignorant of the more refined principles of mechanics. Next to gold, the chief commerce of the place conſiſts in the ſale of fiſh, of which they catch prodigious quantities on the coaſt. Although the natives are brave and warlike, yet in time of peace no people are more induſtrious, their whole time being employed in catching fiſh or cultivating the fruits of the earth. They are extremely expert in throwing the line, and fiſhing by the hook; nor is their intrepidity in combating the elements, and purſuing their employments in all kinds of weather, leſs aſtoniſhing. Every day in the week, except Wedneſday, which is ſacred to the Fetiche, they employ in their ſeveral occupations, and no ſeaſon of the year is exempted from fiſhing. Their canoes weather ſtorms which would endanger the largeſt ſhipping; and the negroes have the dexterity of making their advantage of thoſe ſeaſons, which oblige others to diſcontinue their labours, by throwing their lines with the ſame ſucceſs in tempeſtuous as in calm weather.

OELAND, an iſland of Sweden, ſeated in the Baltic ſea, between the continent of Gothland and the iſle of Gothland. It lies between 56° and 57° of north latitude, and between 17° and 18° of eaſt longitude. It is about 60 miles in length, and 15 in breadth; having a wholeſome air, and a fertile ſoil, with riſing hills, and ſeveral caſtles. It has no town of any great note.

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

OENOPTÆ, in Grecian antiquity, a kind of cenſors fors at Athens, who regulated entertainments, and took care that none drank too much, nor too little.

OENOS, in *Ornithology*, the name ufed by authors for the ftock-dove, or wood-pigeon, called alfo by fome *vinago*, fomewhat larger than the common pigeon, but of the fame fhape and general colour. Its neck is of a fine changeable hue, as differently oppofed to the light; and its breaft, fhoulders, and wings, are of a fine purplifh hue, or red wine colour, from whence it has its name *vinago*.

OENOTHERA, TREE-PRIMROSE, a genus of plants belonging to the octandria clafs; and in the natural method ranking under the 17th order, *Calycanthemæ*. See BOTANY *Index*.

OENOTRIA, an ancient name of Italy; fo called from the *Oenotri*, (Virgil); inhabiting between Pæftum and Tarentum, (Ovid). Originally Arcadians, (Dionyfius Halicarnaffæus), who came under the conduct of Oenotrus fon of Lycaon, 17 generations before the war of Troy, or 459 years, at 27 years each generation, and gave name to the people. Cato derives the name from *Oenotrus*, king of the Sabines and Etrufcans; but Varro from *Oenotrus*, king of the Latins; and Servius from the Greek name for wine, for which Italy was famous; of which opinion is Strabo.

OENOTRIDES (Strabo, Pliny), two fmall iflands in the Tufcan fea, over againft Velia, a town of Lucania, called *Pontia* and *Ifcia;* now *Penza* and *Ifchia*, on the coaft of the Principato Citra, or to the weft of Naples. So called from the *Oenotri*, an ancient people of Italy.

OESEL, an ifland of the Baltic fea, at the entrance of the gulf of Livonia. It is about 70 miles in length, and 50 in breadth, and contains 10 parifhes. It is defended by the fortreffes of Airenfburg and Sonneburg. It lies between 22° and 24° of eaft longitude, and between 58° and 59° of north latitude.

OESOPHAGUS, in *Anatomy*, the GULA, or *Gullet*, is a membranaceous canal, reaching from the fauces to the ftomach, and conveying into it the food taken in at the mouth. See ANATOMY, N° 92.

OESTRUS, a genus of infects belonging to the order of diptera. See ENTOMOLOGY *Index*.

OETA, in *Ancient Geography*, a mountain of Theffaly, extending from Thermopylæ weftward to the Sinus Ambracius, and in fome meafure cutting at right angles the mountainous country ftretching out between Parnaffus to the fouth, and Pindus to the north. At Thermopylæ it is very rough and high, rifing and ending in fharp and fteep rocks, affording a narrow paffage between it and the fea from Theffaly to Locris (Strabo), with two paths over it; the one above Trachis, very fteep and high; the other through the country of the Ænianes, much eafier and readier for travellers; by this it was that Leonidas was attacked in rear by the Perfians (Paufanias). Here Hercules laid himfelf on the funeral pile (Silius Italicus, Ovid); the fpot thence called *Pyra* (Livy), who fays, that the extreme mountains to the eaft are called *Oeta;* and hence the poets allege, that day, night, fun, and ftars, arofe from Oeta (Seneca, Statius, Silius Italicus, Catullus, Virgil's *Culex*)—circumftances which fhow the height of this mountain.

OETING, a town of Germany, in Upper Bavaria, under the jurifdiction of Buckhaufen. It is divided into the upper and the lower town, and feated on the river Inn, eight miles weft of Buckhaufen. E. Long. 12. 47. N. Lat. 48. 0. There is a great refort of pilgrims to the old chapel.

OETING, or *Oetingen*, a town of Germany, in the circle of Suabia, and capital of a county of the fame name, feated on the river Wirnitz. E. Long. 10. 45. N. Lat. 48. 52.

OETING, a county of Germany, in the circle of Suabia, bounded on the north and eaft by Franconia; on the fouth by the duchy of Neuburg; and on the weft by that of Wirtemberg. It is about 40 miles from eaft to weft, and 20 from north to fouth.

OFFA's DYKE, an intrenchment caft up by Offa, a Saxon king, to defend England againft the incurfions of the Welfh. It runs through Hertfordfhire, Shropfhire, Montgomeryfhire, Denbighfhire, and Flintfhire.

OFFANTO, a river of Italy, in the kingdom of Naples. It rifes in the Apennine mountains, in the Farther Principato: and paffing by Conza, and Monte Verde, it afterwards feparates the Capitanata from the Bafilicata and the Terra-di-Bari, and then it falls into the gulf of Venice, near Salpe.

OFFENCE, in *Law*, an act committed againft the law, or omitted where the law requires it.

OFFERINGS. The Hebrews had feveral kinds of offerings, which they prefented at the temple. Some were free-will offerings, and others were of obligation. The firft fruits, the tenths, the fin offerings, were of obligation; the peace offerings, vows, offerings of wine, oil, bread, falt, and other things, which were made to the temple or to the minifters of the Lord, were offerings of devotion. The Hebrews called all offerings in general *corban*. But the offerings of bread, falt, fruits, and liquors, as wine and oil, which were prefented to the temple, they called *mincha*. The facrifices are not properly offerings, and are not commonly included under that name. See CORBAN and SACRIFICE.

The offerings of grain, meal, bread, cakes, fruits, wine, falt, and oil, were common in the temple. Sometimes thefe offerings were alone, and fometimes they accompanied the facrifices. Honey was never offered with the facrifices; but it might be offered alone in the quality of firft fruits. Now thefe were the rules that were obferved in the prefenting of thofe offerings, called in Hebrew *mincha*, or *kerbon mincha;* in the Septuagint, *offerings of facrifice;* and the fame by St Jerome, *oblationem facrificii;* but by our tranflators, *meat offerings* (Lev. ii. 1, &c.). There were five forts of thefe offerings: 1. Fine flour or meal. 2. Cakes of feveral forts, baked in an oven. 3. Cakes baked upon a plate. 4. Another fort of cakes, baked upon a gridiron, or plate with holes in it. 5. The firft fruits of the new corn, which were offered either pure and without mixture, or roafted or parched in the ear or out of the ear.

The cakes were kneaded with oil olive, or fried with oil in a pan, or only dipped in oil after they were baked. The bread offered to be prefented upon the altar, was to be without leaven; for leaven was never offered upon the altar, nor with the facrifices. But they might make prefents of common bread to the priefts and minifters of the temple. See CAKE, &c.

The offerings now mentioned were appointed on account

count of the poorer ſort, who could not go to the charge of ſacrificing animals. And even thoſe that offered living victims were not excuſed from giving meal, wine, and ſalt, which was to go along with the greater ſacrifices. And alſo thoſe that offered only oblations of bread or of meal, offered alſo oil, incenſe, ſalt, and wine, which were in a manner the ſeaſoning of it. The prieſt in waiting received the offerings from the hand of him that offered them; laid a part of them upon the altar, and reſerved the reſt for his own ſubſiſtence: that was his right as a miniſter of the Lord. Nothing was burnt quite up but the incenſe, of which the prieſt kept back nothing for his own ſhare.

When an Iſraelite offered a loaf to the prieſt, or a whole cake, the prieſt broke the loaf or the cake into two parts, ſetting that part aſide that he reſerved to himſelf, and broke the other into crumbs; poured oil upon it, ſalt, wine, and incenſe; and ſpread the whole upon the fire of the altar. If theſe offerings be accompanied by an animal for a ſacrifice, it was all thrown upon the victim, to be conſumed along with it.

If theſe offerings were the ears of new corn, either of wheat or barley, theſe ears were parched at the fire or in the flame, and rubbed in the hand, and then offered to the prieſt in a veſſel; over which he put oil, incenſe, wine, and ſalt, and then burnt it upon the altar, firſt having taken as much of it as of right belonged to himſelf.

The greateſt part of theſe offerings were voluntary, and of pure devotion. But when an animal was offered in ſacrifice, they were not at liberty to omit theſe offerings. Every thing was to be ſupplied that was to accompany the ſacrifice, and which ſerved as a ſeaſoning to the victim. There are ſome caſes in which the law requires only offerings of corn, or bread: for example, when they offered the firſt fruits of their harveſt, whether they were offered ſolemnly by the whole nation, or by the devotion of private perſons.

As to the quantity of meal, oil, wine, or ſalt, which was to go along with the ſacrifices, we cannot eaſily ſee that the law had determined it. Generally the prieſt threw an handful of meal or crumbs upon the fire of the altar, with wine, oil, and ſalt in proportion, and all the incenſe. All the reſt belonged to him, the quantity depended upon the liberality of the offerer. We obſerve in more places than one, that Moſes appoints an affaron, or the tenth part of an ephah of meal, for thoſe that had not wherewithal to offer the appointed ſin offerings (Lev. v. 11. xiv. 21.). In the ſolemn offerings of the firſt fruits for the whole nation, they offered an entire ſheaf of corn, a lamb of a year old, two tenths or two affarons of fine meal mixed with oil, and a quarter of an hin of wine for the libation. (Lev. xxiii. 10, 11, 12, &c.).

In the ſacrifice of jealouſy (Numb. v. 15.), when a jealous huſband accuſed his wife of infidelity, the huſband offered the tenth part of a fatum of barley-meal, without oil or incenſe, becauſe, it was a ſacrifice of jealouſy, to diſcover whether his wife was guilty or not.

The offerings of the fruits of the earth, of bread, of wine, oil, and ſalt, are the moſt ancient of any that have come to our knowledge. Cain offered to the Lord of the fruits of the earth, the firſt fruits of his labour (Gen. iv. 3, 4.). Abel offered the firſtlings of his flocks, and of their fat. The heathen have nothing more ancient in their religion, than theſe ſorts of offerings made to their gods. They offered clean wheat, flour, and bread.

OFFICE, a particular charge or truſt, or a dignity attended with a public function. See HONOUR.—The word is primarily uſed in ſpeaking of the offices of judicature and policy; as the office of ſecretary of ſtate, the office of a ſheriff, of a juſtice of peace, &c.

OFFICE alſo ſignifies a place or apartment appointed for officers to attend in, in order to diſcharge their reſpective duties and employments; as the ſecretary's office, ordnance office, exciſe office, ſignet office, paper office, pipe office, ſix clerks office, &c.

OFFICE, in *Architecture*, denotes all the apartments appointed for the neceſſary occaſions of a palace or great houſe; as kitchen, pantries, confectionaries, &c.

OFFICE, in the canon law, is uſual for a benefice, that has no juriſdiction annexed to it.

Duty upon OFFICES *and Penſions*, a branch of the king's extraordinary perpetual revenue, conſiſting in a payment of 1s. in the pound (over and above all other duties) out of all ſalaries, fees, and perquiſites of offices and penſions payable by the crown. This highly popular taxation was impoſed by ſtat. 31 Geo. II. c. 22. and is under the direction of the commiſſioners of the land tax.

OFFICER, a perſon poſſeſſed of a poſt or office. See the preceding article.

The great officers of the crown, or ſtate, are, The lord high ſteward, the lord high chancellor, the lord high treaſurer, the lord preſident of the council, the lord privy ſeal, the lord chamberlain, the lord high conſtable, and the earl marſhal; each of which ſee under its proper article.

Non-commiſſioned OFFICERS, are ſerjeant majors, quartermaſter ſerjeants, ſerjeants, corporals, drum and fife majors; who are nominated by their reſpective captains, and appointed by the commanding officers of regiments, and by them reduced without a court martial.

Orderly non-commiſſioned OFFICERS, are thoſe who are orderly, or on duty for that week; who, on hearing the drum beat for orders, are to repair to the place appointed to receive them, and to take down in writing, in the orderly book, what is dictated by the adjutant, or ſerjeant major: they are then immediately to ſhow theſe orders to the officers of the company, and afterwards warn the men for duty.

Flag OFFICERS. See FLAG *Officers*, and ADMIRALS.

Commiſſion OFFICERS, are ſuch as are appointed by the king's commiſſion. Such are all from the general to the cornet and enſign incluſive. They are thus called in contradiſtinction to non-commiſſioned officers. See *Non-commiſſioned* OFFICERS.

General OFFICERS, are thoſe whoſe command is not limited to a ſingle company, troop, or regiment; but extends to a body of forces compoſed of ſeveral regiments: ſuch are the general, lieutenant general, major general, and brigadier.

OFFICERS *of the Houſehold*. See the article HOUSEHOLD.

Staff OFFICERS, are ſuch as, in the king's preſence, bear a white ſtaff or wand; and at other times, on their

their going abroad, have it carried before them by a footman bare-headed: such are the lord steward, lord chamberlain, lord treasurer, &c.

The white staff is taken for a commission; and, at the king's death, each of these officers breaks his staff over the herse made for the king's body, and by this means lays down his commission, and discharges all his inferior officers.

Subaltern OFFICERS, are all who administer justice in the name of subjects; as those who act under the earl marshal, admiral, &c. In the army, the subaltern officers are the lieutenants, cornets, ensigns, serjeants, and corporals.

OFFICIAL, in the canon law, an ecclesiastical judge, appointed by a bishop, chapter, abbot, &c. with charge of the spiritual jurisdiction of the diocese.

OFFICIAL, is also a deputy appointed by an arch-deacon as his assistant, who sits as judge in the arch-deacon's court.

OFFICINAL, in *Pharmacy*, an appellation given to such medicines, whether simple or compound, as are required to be constantly kept in the apothecaries shops. The *officinal simples* are appointed, among us, by the College of Physicians; and the manner of making the compositions directed in their pharmacopoeia. See MATERIA MEDICA.

OFFING, or OFFIN, in the sea language, that part of the sea a good distance from shore, where there is deep water, and no need of a pilot to conduct the ship: thus, if a ship from shore be seen sailing out to seaward, they say, *she stands for the offing*; and if a ship, having the shore near her, have another a good way without her, or towards the sea, they say, *that ship is in the offing*.

OFF-SETS, in *Gardening*, are the young shoots that spring from the roots of plants; which being carefully separated, and planted in a proper soil, serve to propagate the species.

OFF-SETS, in *Surveying*, are perpendiculars let fall, and measuring from the stationary lines to the hedge, fence, or extremity of an enclosure.

OGEE, or O. G. in *Architecture*, a moulding consisting of two members, the one concave and the other convex; or of a round and hollow, like an S. See ARCHITECTURE.

OGHAMS, a particular kind of steganography, or writing in cypher, practised by the Irish; of which there were three kinds: The first was composed of certain lines and marks, which derived their power from their situation and position, as they stand in relation to one principal line, over or under which they are placed, or through which they are drawn; the principal line is horizontal, and serveth for a rule or guide, whose upper part is called the left, and the under side the right; above, under, and through which line, the characters or marks are drawn, which stand in the place of vowels, consonants, diphthongs, and triphthongs. Some authors have doubted the existence of this species of writing in cypher, called *Ogham* among the Irish: but these doubts are perhaps ill founded: for several MSS. in this character still exist, from which Mr Astle has given a plate of them.

OGIVE, in *Architecture*, an arch or branch of a Gothic vault; which, instead of being circular, passes diagonally from one angle to another, and forms a cross with the other arches. The middle, where the ogives cross each other, is called the *key*; being cut in form of a rose, or a *cul de lampe*. The members or mouldings of the ogives are called *nerves*, *branches*, or *reins*; and the arches which separate the ogives, *double arches*.

OGYGES, king of the Thebans, or, according to others, of Ogygia and Actæ, afterwards called *Bœotia* and *Attica*. He is recorded to have been the first founder of Thebes and Eleusis. The famous deluge happened in his time, in which some say he perished with all his subjects, 1796 B. C.

OGYGIA (Homer), the island of Calypso; placed by Pliny in the Sinus Scylaceus, in the Ionian sea, opposite to the promontory Lacinium; by Mela in the strait of Sicily, calling it *Ææa*; which others place at the promontory Circeium, and call it the island of *Circe*.

OGYGIA, the ancient name of Thebes in Bœotia: so called from Ogyges, an ancient king, under whom happened a great deluge, 1020 years before the first Olympiad.

OHIO, a river of North America, having its source in the Alleghany mountains, and after them is called Alleghany, till it joins the Monongahela at Fort Pitt, where it receives the name of Ohio. It bounds the state of Kentucky, and its only disadvantage is a rapid, one mile and a half long, in N. Lat. 38. 3. about 400 miles from its mouth. The breadth of this river in no one place exceeds 1200 yards, but its mean breadth may be estimated at 600 yards, and its length almost 1200 miles, according to the measurement of Captain Hutchins. The inundations of the Ohio begin about the end of March, and subside in July, although they have been known to happen frequently in other months; so that boats which are capable of carrying 300 barrels of flour from the Monongahela above Pittsburg, have seldom very long to wait for water. It is thought that, during the great floods, a first rate man of war might sail from Louisville to New Orleans, if the sudden turns of the river, and the rapidity of its current, should be found to admit of a safe steerage. The bed of the Ohio is a solid rock, and is divided by an island into two branches, the southern of which is about 200 yards wide, but impassable in dry seasons. It is the branch that may be most easily opened for a constant navigation, as the bed of the northern branch is worn into channels by the constant course of the water, and the attrition of the pebble stones carried along with it.

OHIO is also the name of the north-westermost county of the state of Virginia, bounded on the east by the county of Washington in Pennsylvania. It contains 5,212 inhabitants, of whom 281 are slaves.

OHETEROA, one of the South sea islands lately discovered, is situated in W. Long. 150. 47. S. Lat. 22. 27. It is neither fertile nor populous; nor has it any harbour or anchorage fit for shipping, and the disposition of the people is hostile to such as visit them.

OIL, an unctuous inflammable substance, drawn from several natural bodies, as animal and vegetable substances. See CHEMISTRY and MATERIA MEDICA *Index*.

For an account of the construction of an oil mill, see Gray's Experienced Millwright; and for an account of a very simple apparatus for expressing oils from different feeds at Bangalore in the Eaſt Indies, ſee Phil. Mag. vol. xxx. p. 329.

Rock Oil. See PETROLEUM, MINERALOGY *Index*.

OINTMENT, in *Pharmacy*. See UNGUENT, MATERIA MEDICA *Index*.

OKEHAM, the capital of Rutlandſhire, in England, ſeated in a rich and pleaſant valley, called the *vale of Catmus*. It is pretty well built, has a good church, a free-ſchool, and an hoſpital. W. Long. 0. 45. N. Lat. 52. 40.

OKINGHAM, OCKINGHAM, or *Woxingham*, a large town of Berkſhire, in England, noted for the manufacture of ſilk ſtockings. W. Long. 0. 50. N. Lat. 51. 26.

OLAUS MAGNUS. See MAGNUS.

OKRA, the fruit of a ſpecies of hibiſcus, which is employed in the Weſt Indies in making ſoups. See BOTANY *Index*.

OLAX, a genus of plants, belonging to the triandria claſs. See BOTANY *Index*.

OLD AGE. See LONGEVITY. Many methods have been propoſed for lengthening life, and rendering old age comfortable. Cornaro's Treatiſe on this ſubject is known to every body, and needs not be quoted. To ſome of our readers the following ſet of reſolutions will perhaps be new, and may certainly be uſeful.

The old men ſhould reſolve, except the reaſons for a change be invincible, to live and to die in the public profeſſion of the religion in which they were born and bred. To avoid all profane talk and intricate debates on ſacred topics. To endeavour to get the better of the intruſions of indolence of mind and body, thoſe certain harbingers of enfeebling age. Rather to wear out, than to ruſt out. To riſe early, and as often as poſſible to go to bed before midnight. Not to nod in company, nor to indulge repoſe too frequently on the couch in the day. To waſte as little of life in ſleep as may be, for we ſhall have enough in the grave. Not to give up walking; nor to ride on horſeback to fatigue. Experience, and a late medical opinion, determine to ride five miles every day: Nothing contributes more to the preſervation of appetite, and the prolongation of life. Cheyne's direction to the valetudinary, "to make exerciſe a part of their religion," to be religiouſly obſerved. To continue the practice of reading, purſued for more than fifty years, in books on all ſubjects; for variety is the ſalt of the mind as well as of life. Other people's thoughts, like the beſt converſation of one's companions, are generally better and more agreeable than one's own. Frequently to think over the virtues of one's acquaintance, old and new. To admit every cheerful ray of ſunſhine on the imagination. To avoid retroſpection on a paſt friendſhip, which had much of love in it; for memory often comes when ſhe is not invited. To try to think more of the living and leſs of the dead; for the dead belong to a world of their own. To live within one's income, be it large or little. Not to let paſſion of any ſort run away with the underſtanding. Not to encourage romantic hopes nor fears. Not to drive away hope, the ſovereign balm of life, though he is the greateſt of all flatterers. Not to be under the dominion of ſuperſtition or enthuſiaſm. Not wilfully to undertake any thing for which the nerves of the mind or the body are not ſtrong enough. Not to run the race of competition, or to be in another's way. To avoid being joſtled too much in the ſtreet, being overcome by the noiſe of the carriages, and not to be carried even by curioſity itſelf into a large crowd. To ſtrive to embody that dignified ſentiment, "to write injuries in duſt, but kindneſſes in marble." Not to give the reins to conſtitutional impatience, for it is apt to hurry on the firſt expreſſions into the indecency of ſwearing. To recollect, that he who can keep his own temper may be maſter of another's. If one cannot be a ſtoic, in bearing and forbearing, on every trying occaſion, yet it may not be impoſſible to pull the check-ſtring againſt the moroſeneſs of ſpleen or the impetuoſity of peeviſhneſs. Anger is a ſhort madneſs. Not to fall in love, now on the precipice of threeſcore, nor expect to be fallen in love with. A connexion between ſummer and winter is an improper one. Love, like fire, is a good ſervant, but a bad maſter. Love is death, when the animal ſpirits are gone. To contrive to have as few vacant hours upon one's hands as poſſible, that idleneſs, the mother of crimes and vices, may not pay its viſit. To be always doing of ſomething, and to have ſomething to do. To fill up one's time, and to have a good deal to fill up: for time is the materials that life is made of. If one is not able by ſituation, or through the neceſſity of raiſing the ſupplies within the year, or by habit (for virtue itſelf is but habit), to do much oſtentatious good, yet do as little harm as poſſible. To make the beſt and the moſt of every thing. Not to indulge too much in the luxury of the table, nor yet to underlive the conſtitution. The gout, rheumatiſm, and dropſy, in the language of the Spectator, ſeem to be hovering over the diſhes. Wine, the great purveyor of pleaſure, and the ſecond in rank among the ſenſes, offers his ſervice, when love takes his leave. It is natural to catch hold of every help, when the ſpirits begin to droop. Love and wine are good cordials, but are not proper for the beverage of common uſe. Reſolve not to go to bed on a full meal. A light ſupper and a good conſcience are the beſt receipts for a good night's reſt, and the parents of undiſturbing dreams. Not to be enervated by the flatulency of tea. Let the ſecond or third morning's thought be to conſider of the employment for the day; and one of the laſt at night to inquire what has been done in the courſe of it. Not to let one's tongue run at the expence of truth. Not to be too communicative nor unreſerved. A cloſe tongue, with an open countenance, are the ſafeſt paſſports through the journey of the world. To correct the error of too much talking, and reſtrain the narrativeneſs of the approaching climacteric. To take the good-natured ſide in converſation. However, not to praiſe every body, for that is to praiſe nobody. Not to be inquiſitive, and eager to know ſecrets, nor be thought to have a head full of other people's affairs. Not to make an enemy, nor to loſe a friend. To aim at the eſteem of the public, and to leave a good name behind. Not to be ſingular in dreſs, in behaviour, in notions, or expreſſions of one's thoughts. Never to give bad advice, and to ſtrive not to ſet a bad example. Seldom to give advice till aſked, for it appears like giving ſomething that is ſuperfluous to one's ſelf. Not to like or diſlike too much at firſt ſight. Not to wonder, for all wonder is ignorance that poſſeſſion falls ſhort of expectation. The longing of twenty years may be diſappointed in the unanſwered gratification of a ſingle hour.

Old || Oldcastle.

hour. Whilst we are wishing, we see the best side; after we have taken possession, the worst. Resolve to attend to the arguments on both sides, and to hear every body against every body. The mind ought not to be made up, but upon the best evidence. To be affectionate to relations, which is a kind of self-love, in preference to all other acquaintance. But not to omit paying the commanding respect to merit, which is superior to all the accidental chain of kindred. Not to debilitate the mind by new and future compositions. Like the spider, it may spin itself to death. The mind, like the field, must have its fallow season. The leisure of the pen has created honourable acquaintance, and pleased all it has wished to please. To resolve not to be too free of promises, for performances are sometimes very difficult things. Not to be too much alone, nor to read, nor meditate, or talk too much on points that may awaken tender sensations, and be too pathetic for the soul. To enjoy the present, not to be made too unhappy by reflection on the past, not to be oppressed by invincible gloom on the future. To give and receive comfort, those necessary alms to a distressed mind. To be constantly thankful to providence for the plenty hitherto possessed, which has preserved one from the dependence on party, persons, and opinions, and kept one out of debt. The appearance of a happy situation, and opportunities of tasting many worldly felicities (for content has seldom perverted itself into discontent), has induced many to conclude, that one must be pleased with one's lot in life; and it occasions many to look with the eye of innocent envy. To resolve more than ever to shun every public station and responsibility of conduct. To be satisfied with being master of one's self, one's habits, now a second nature, and one's time. Determined not to solicit, unless trampled upon by fortune, to live and die in the harness of trade, or a profession. To take care that pity (humanity is not here meant) does not find out one in the endurance of any calamity. When pity is within call, contempt is not far off. Not to wish to have a greater hold of life, nor to quit that hold. The possible tenure of existence is of too short possession for the long night that is to succeed: therefore not a moment to be lost. Not to lose sight even for a single day, of these good and proverbial doctors—diet—merryman—and quiet. Resolved to remember and to recommend, towards tranquillity and longevity, the three oral maxims of Sir Hans Sloane —"Never to quarrel with one's self—one's wife—or one's prince." Lastly, Not to put one's self too much in the power of the elements, those great enemies to the human frame; namely, the sun—the wind—the rain—and the night air.

OLD Man of the Mountain. See ASSASSINS.

OLDCASTLE, Sir John, called the *Good Lord Cobham*, was born in the reign of Edward III. and was the first author as well as the first martyr among the English nobility: he obtained his peerage by marrying the heiress of that Lord Cobham who with so much virtue and patriotism opposed the tyranny of Richard II. By his means the famous statute against provisors was revived, and guarded against by severer penalties; he was one of the leaders of the reforming party; was at great expence in procuring and dispersing copies of Wickliffe's writings among the people, as well as by maintaining a number of his disciples as itinerant preachers. In the reign of Henry V. he was accused of heresy; the growth of which was attributed to his influence. Being a domestic in the king's court, the king delayed his prosecution that he might reason with him himself; but not being able to reclaim him to the church of Rome, he in great displeasure resigned him to its censure. He was apprehended and condemned for heresy; but escaping from the Tower, lay concealed for four years in Wales, until the rumour of a pretended conspiracy was raised against him, and a price set upon his head: he was at last seized and executed in St Giles's Fields; being hung alive in chains upon a gallows, and burned by a fire placed underneath. He wrote "Twelve Conclusions, addressed to the Parliament of England."

Oldcastle, Oldenburg.

OLDENBURG, a title of the royal house of Denmark. The origin of this illustrious family, we are told, is this:—

On the death of Christopher king of Denmark, &c. in 1448, without issue, there was a great contest about the succession; and a variety of factions were raised, particularly in Sweden and Norway, for the promotion of different persons; and various animosities and numerous discords were excited by the several parties, in order each to obtain their own ends.

As soon as these intrigues were known in Denmark, the senate resolved to procced to the election of a king; for it did not appear expedient to commit the government of affairs to the queen dowager, at a time when they had every thing to fear from the two neighbouring crowns. At this time a lord of great weight, property, and ambition, sought the queen in marriage, the more easily to pave his way to the throne. This is a fact mentioned by Pontanus and Meursius, though neither takes notice of his name. But as for a great number of years there was no precedent for electing a king out of the body of nobility, though agreeable to law, the queen entered into the views of the senate, and declared she would give her hand to no prince who should not be judged deserving of the crown by the supreme council of the nation.

The advantages which would have accrued from annexing the duchy of Sleswick and Holstein to the crown, made the senate first cast their eyes on Adolphus. This matter required no long deliberation; all saw the conveniences resulting from such an union, and gave their assent. Immediately an embassy was despatched with the offer to Adolphus; but that prince consulting the good of his subjects, whose interest would have been absorbed in the superior weight of Denmark, declined it, with a moderation and disinterestedness, altogether uncommon among princes. However, that he might not be wanting in respect to the senate, he proposed to them his nephew Christian, second son to Theodoric, count of Oldenburg, a prince bred up at the court of Adolphus from his infancy. The proposition was so agreeable to the senate, that, without loss of time, the ambassadors were sent to Theodoric, to demand either of his sons he should pitch upon for their king. Theodoric's answer to the ambassadors was remarkable: "I have three sons, says he, of very opposite qualities. One is passionately fond of pleasure and women; another breathes nothing but war, without regarding the justice of the cause; but the third is moderate in his disposition, prefers

prefers peace to the din of arms, yet ftands unrivalled in valour, generofity, and magnanimity." He faid he painted thefe characters for the fenate's information, defiring they would choofe which of the young princes they believed would render the kingdom happieft. It was a matter which would admit of no hefitation: with one voice the fenate declared for that prince whofe panegyric the father had fo warmly drawn; and under thefe happy aufpices commenced the origin of the grandeur of the houfe of Oldenburg, at this day feated on the throne of Denmark.

OLDENBURG, *Henry*, a learned German of the 17th century, was defcended from the noble family of his name, who were earls of the county of Oldenburg, in the north part of Weftphalia, for many generations. He was born in the duchy of Bremen in the Lower Saxony; and during the long Englifh parliament in King Charles I.'s time, was appointed conful for his countrymen, at London, after the ufurpation of Cromwell; but being difcharged of that employ, he was made tutor to the lord Henry O'Bryan, an Irifh nobleman, whom he attended to the univerfity of Oxford, where he was admitted to ftudy in the Bodleian library in the beginning of the year 1656. He was afterwards tutor to William lord Cavendifh, and was acquainted with Milton the poet. During his refidence at Oxford, he became alfo acquainted with the members of that body there, which gave birth to the Royal Society; and upon the foundation of this latter, he was elected fellow; and when the fociety found it neceffary to have two fecretaries, he was chofen affiftant fecretary to Dr Wilkins. He applied himfelf with extraordinary diligence to the bufinefs of his office, and began the publication of the Philofophical Tranfactions with N° I. in 1664. In order to difcharge this tafk with greater credit to himfelf and the fociety, he held a correfpondence with more that feventy learned perfons, and others, upon a vaft variety of fubjects, in different parts of the world. This fatigue would have been infupportable, had not he, as he told Dr Lifter, managed it fo as to make one letter anfwer another; and that to be always frefh, he never read a letter before he had pen, ink, and paper, ready to anfwer it forthwith; fo that the multitude of his letters cloyed him not, nor ever lay upon his hands. Among others, he was a conftant correfpondent of Mr Robert Boyle, with whom he had a very intimate friendfhip; and he tranflated feveral of that ingenious gentleman's works into Latin.

Mr Oldenburg continued to publifh the Tranfactions, as before, to N° xxxvi. June 25. 1677. After which the publication was difcontinued till the January following, when it was again refumed by his fucceffor in the fecretary's office, Mr Nehemiah Grew, who carried it on till the end of February 1678. Our author dying at his houfe at Charleton, near Greenwich in Kent, in the month of Auguft that year, was interred there.

OLDENLANDIA, a genus of plants belonging to the tetrandria clafs. See BOTANY *Index*.

OLDHAM, JOHN, an eminent Englifh poet in the 17th century, fon of a Nonconformift minifter, was educated under his father, and then fent to Edmund-hall in Oxford. He became ufher to the free-fchool at Croydon in Surry; where he received a vifit from the earls of Rochefter and Dorfet, Sir Charles Sedley, and other perfons of diftinction, merely upon the reputation of fome verfes of his which they had feen in manufcript. He was tutor to feveral gentlemen's fons fucceffively; and having faved a fmall fum of money, came to London, and became a perfect votary to the bottle, being an agreeable companion. He was quickly found out here by the noblemen who had vifited him at Croydon, who brought him acquainted with Mr Dryden. He lived moftly with the earl of Kingfton at Holme-Pierpoint in Nottinghamfhire, where he died of the fmallpox in 1683, in the 30th year of his age. His acquaintance with learned authors appears by his fatires againft the Jefuits, in which there is as much learning as wit difcovered. Mr Dryden efteemed him highly. His works are printed in 2 vols 12mo. They chiefly confift of fatires, odes, tranflations, paraphrafes of Horace and other authors, elegiac verfes, imitations, parodies, familiar epiftles, &c.

OLD-HEAD, a promontory fituated in the county of Cork, and province of Munfter, four miles fouth of Kinfale, in the barony of Courcies, Ireland, which runs far into the fea, and on which is a lighthoufe for the convenience of fhipping. A mile from its extremity is an ancient caftle of the lords of Kinfale, built from one fide of the ifthmus to the other, which defended all the lands towards the head: this place was formerly called *Duncearma*, and was the old feat of the Irifh kings. The ifthmus, by the working of the fea, was quite penetrated through, fo as to form a ftupendous arch, under which boats might pafs from one bay to the other. Among the rocks of this coaft there are aviaries of good hawks; alfo the fea eagles or ofpreys build their nefts and breed there.

OLDMIXON, JOHN, was defcended from an ancient family in Somerfetfhire: he was a violent party-writer and malevolent critic, who would fcarcely have been remembered, if Pope, in refentment of his abufe, had not condemned him to immortality in his Dunciad. His party-writings procured him a place in the revenue at Liverpool, where he died at an advanced age in the year 1745. Befides his fugitive temporary pieces, he wrote a Hiftory of the Stuarts, in folio; a Critical Hiftory of England, 2 vols 8vo; a volume of Poems, fome dramatic pieces, &c.; none of them worthy of notice, his principal talent being that of falfifying hiftory.

OLD-WIFE, or *Wraffe*. See LABRUS, } ICHTHYOLOGY *Index*.
OLD-WIFE *Fifh*. See BALISTES, } ICHTHYOLOGY *Index*.

OLD-WOMAN'S ISLAND, a narrow flip of land, about two miles long, feparated from Bombay in the Eaft Indies by an arm of the fea, which, however, is paffable at low water. It terminates at one extremity in a fmall eminence, on which a look-out houfe is kept for veffels. Near the middle are three tombs kept conftantly white, as land-marks into the harbour. From the end of the ifland a dangerous ledge of rocks fhoots forth, which are not very eafily cleared. It produces only pafture for a few cattle.

OLEA, the *olive-tree;* a genus of plants belonging to the diandria clafs; and in the natural method ranking under the 44th order, *Sepiariæ*. See BOTANY *Index*.

OLEAGINOUS, fomething that partakes of the nature of oil, or out of which oil may be expreffed.

OLEANDER, or ROSE BAY, *nerium;* a genus of plants belonging to the pentandria class. See BOTANY *Index.*

OLECRANUM, or OLECRANON, in *Anatomy*, the protuberance of the ulna, which prevents the joint of the elbow from being bent back beyond a certain length. See ANATOMY, N° 51.

OLENUS, a Greek poet, older than Orpheus, came from Xanthe, a city of Lycia. He composed several hymns, which were sung in the island of Delos upon festival days. Olenus is said to have been one of the founders of the oracle at Delphi; to have been the first who filled at that place the office of priest of Apollo; and to have given responses in verse: but the truth of these assertions is very doubtful.

OLERON, an island of France, on the coast of Aunis and Saintogne, about five miles from the continent. It is 12 miles in length, and five in breadth; and is very fertile, containing about 12,000 inhabitants, who are excellent seamen. It is defended by a castle, which is well fortified; and there is a lighthouse placed there for the direction of ships. It is 14 miles south-east of Rochelle. W. Long. 1. 26. N. Lat. 46. 3.

Sea Laws of OLERON, certain laws relative to maritime affairs, made in the time of Richard I. when he was at the island of Oleron. These laws, being accounted the most excellent sea laws in the world, and recorded in the black book of the admiralty. See Selden's *Mare Clausum.*

OLEUM PALMÆ CHRISTI, commonly called *castor oil*, is extracted from the kernel of the fruit produced by the *Ricinus Americanus.* See RICINUS, BOTANY and MATERIA MEDICA *Index.*

OLFACTORY NERVES. See ANATOMY, N° 139 and 143.

OLGA, queen of Igor, the second monarch of Russia, who flourished about the year 880, having succeeded his father Ruric, who died in 878. Olga was born in Plescow, and was of the best family in that city. She bore him one son, called *Swetoslaw.* Igor being murdered by the Drewenses, or Drewliani, Olga revenged his death. She went afterwards, for what reason we know not, to Constantinople, where she was baptized, and received the name of *Helena.*

The emperor John Zimisces was her godfather, and fell in love with her as we are told; but she, alleging their spiritual alliance, refused to marry him. Her example made some impression upon her subjects, a good number of whom became converts to Christianity; but none upon her son, who reigned for a long time after her death, which happened at Pereslaw, in the 80th year of her age, 14 years after her baptism. The Russians to this day rank her among their saints, and commemorate her festival on the 11th of July.

OLIBANUM, in *Pharmacy*, a gummy resin, (the product of the *juniperus lycia* Lin.), brought from Turkey and the East Indies, usually in drops or tears. See MATERIA MEDICA *Index.*

OLIGARCHY, a form of government wherein the administration of affairs is confined to a few hands.

OLIO, or OGLIO, a favoury dish, or food, composed of a great variety of ingredients; chiefly found at Spanish tables.

The forms of olios are various. To give a notion of this strange assemblage, we shall here add one from an approved author.

Take rump of beef, neats tongues boiled and dried, and Bologna sausages; boil them together, and, after boiling two hours, add mutton, pork, venison and bacon, cut in bits; as also turnips, carrots, onions and cabbage, borage, endive, marigolds, sorrel, and spinach; then spices, as saffron, cloves, mace, nutmeg, &c. This done, in another pot put a turkey or goose, with capons, pheasants, wigeons and ducks, partridges, teals, and stock-doves, snipes, quails, and larks, and boil them in water and salt. In a third vessel, prepare a sauce of white wine, strong broth, bntter, bottoms of artichokes, and chesnuts, with cauliflowers, bread, marrow, yolks of eggs, mace, and saffron. Lastly, Dish the olio, by first laying out the beef and veal, then the venison, mutton, tongues, and sausages, and the roots over all; then the largest fowls, then the smallest, and lastly pour on the sauce.

OLISIPO, (Pliny, Antonine, Inscriptions); a town of Lusitania, situated on the north side of the frith of the Tagus; of such antiquity, that Solinus thought it was built by Ulysses; and Mela, probably to favour this opinion, writes, according to the common copies, *Ulyssipo;* both of them perhaps deceived by the similarity of sound. It was a municipium, with the surname *Felicitas Julia*, a privilege granted by the munificence of Augustus, (Inscriptions, Pliny). Now Lisbon, capital of Portugal, situated on the north bank of the Tagus, distant about ten miles from its mouth. See LISBON.

OLIVAREZ, COUNT DE, by name *Don Gaspar de Guzman*, favourite and minister to Don Philip IV. of Spain, about 1620; a man of great parts and boundless ambition. Philip no sooner became king, than he became the subject of this his favourite. The king had abilities, it is true, but they lay dormant; and whilst he spent his time in listless inactivity, the whole government was under the direction of Olivarez. The count's management, indeed, was sufficiently dexterous in accomplishing his own designs; for by the best framed excuses, and on the most plausible pretexts, he removed all such as he thought stood in his way; nor did he stop there, but sometimes persecuted his rivals even to death, of which Don Rodrigo Calderona was a melancholy instance, an instance which at that time excited universal compassion. This minister, in short, had a genius of no common kind; added to which, he had a disposition which spurned all controul.

He had persecuted the late ministry for their pusillanimity in the management of affairs; he therefore thought it necessary, and it was certainly prudent, to pursue new measures. His self-sufficiency, though unbounded, was concealed under the veil of assumed modesty, and he was careful to make it appear that he was wholly taken up with the things of his own province. His politics were of a refined perhaps, but not of a very useful, tendency; for his imprudence, or his wrong notions on the subject, made him renew a war with Holland, contrary to the universal opinion of the council and the people. By the same imprudence, or by something worse, he provoked England, and obliged her to endeavour to humble the pride and lessen the authority of the house of Austria. Thus far he had been of little

Olivarez. ſervice to his country, having only provoked the reſentment of the moſt powerful ſtates, particularly England, France, Holland, &c. to conſpire for its ruin. It is remarkable that Olivarez, notwithſtanding this, never loſt his credit; and indeed things ſo turned about in the end, that though Spain for a whole year was put to the ſevereſt trials, it acquired a degree of fame which ſufficiently, in the general opinion, overbalanced ſome little loſs. Olivarez too was particularly fortunate in making the peace; in which tranſaction he gained a very conſiderable advantage over Richelieu, ſo that things appeared to be ſtill in a very favourable train. Fortune, however, was not always quite ſo indulgent to the ſchemes of this miniſter: he again drew Spain into a war with Mantua, contrary to the ſentiments of the wiſeſt men; from which is juſtly dated its declenſion, if not its ruin.

On the whole, Olivarez ſeems to have been always averſe to peace; and with ſuch a reſtleſs diſpoſition, it is undoubtedly wonderful that he held his place ſo long and with ſo few complaints as he did.

It was certainly owing to his ambition and obſtinacy, that an almoſt general war was excited about the year 1627, and which, as we have ſaid, proved ſo fatal to Spain. So averſe, indeed, does he appear to have been to peace, that he uſed every means in his power to prevent the reſtoration of it in Italy; and for this very purpoſe he ſent Feria into Milan, whom he knew to be a man of ſuch a temper and abilities as ſuited his purpoſes; for he was naturally averſe to quiet. He endeavoured to break the alliances of the duke of Mantua by various ſtratagems; but they did not ſucceed: the ſchemes of Olivarez and the intrigues of Feria being totally defeated. Our miniſter had ſoon after this another cauſe of mortification, on Richelieu's being created a duke and peer of France, and unanimouſly admitted among the Venetian nobility; which could not fail to be a ſevere ſtroke on Olivarez, who conſidered him as his implacable enemy.

The people at length began to ſee and be diſpleaſed with his conduct; and with reaſon, had they known it all, for it was in many inſtances cruel and deteſtable. Indeed the differences which at that time had ſo long ſubſiſted between France and Spain were the effect of the private animoſity between him and Richelieu. Things, however, ſo turned about, and Spain was ſo unuſually ſucceſsful, that the faults of the miniſter were overlooked for the time; but this unexpected good fortune had no other effect than that of making him far more inſolent than ever. He was, in every inſtance, one of the moſt headſtrong and obſtinate men in the world: he had ſet his heart on the reduction of Caſal in Italy, and he was determined on it at whatever hazard; this fooliſh enterpriſe was, however, unaccountably defeated, and the Spaniſh army experienced a total defeat.

The revolt of the Catalans, whom he wiſhed to deprive of their privileges, was the next conſequence of his folly: he had privately employed the marquis de los Velez to extinguiſh this rebellion; but the cruelty of the meaſures uſed for this purpoſe only inflamed it the more. The revolution of Portugal, another diſaſtrous event, was alſo the reſult of his obſtinacy and rigour.

This ſeries of ill fortune, which ought to have opened the eyes of the Catholic king and his miniſters, ſeemed to infatuate both. The great ſecret by which Olivarez had governed his maſter was being the companion, or at leaſt the confidant, of his pleaſures. While he affected to deceive the world with a ſpecious appearance of religion and piety, he was not only immerſed in vice himſelf, but encouraged and promoted it in his prince, to the ſcandal of his ſubjects, and the prejudice of his affairs. At this time, of all others the moſt improper, Olivarez produced a baſtard of his, hitherto called *Julian*; he had taken ſo little care of this ſon, that, not able to ſubſiſt in Spain, he had paſſed over to the Indies, where, in very mean ſtations, he had ſcarcely got bread. On him he now beſtowed the name of *Don Henrico de Guzman*; and bringing him with great pomp and ſplendour to court, either flattered or forced the conſtable of Caſtile to give him his daughter; in conſideration of which alliance he was to devolve upon him his duchy of St Lucar. In the beginning of his adminiſtration, by ſome accident or other, he preſented to the king a memorial, in relation to an affair upon which his majeſty had already received one from Don Balthaſar de Zuniga: upon comparing them, they contradicted each other flatly. The king ordered a perſon of great quality to inquire thoroughly into this buſineſs; in conſequence of which Don Balthaſar's memorial appeared to be the truth, and that of Olivarez the reverſe of it. The king was very angry; but the count regained his favour, by procuring for him the fair actreſs Calderona. By this woman he had a ſon, of whom no great notice was taken; but now, to obſcure the folly of the count duke, this youth, ſcarce in the 14th year of his age, was produced, with the title of *Don Juan of Auſtria*, and declared generaliſſimo of the army againſt Portugal; while the heir apparent to the crown, Don Balthaſar, was left under the tuition, or rather in the cuſtody of the counteſs of Olivarez; at which conduct the queen was chagrined, the people enraged, and the world in general aſtoniſhed.

His ſchemes now began to be entirely broken and defeated everywhere and in every kind; he fell under the diſpleaſure of the queen, the emperor, the grandees, and the people all at once, and experienced the diſgrace he had long merited. His ill fortune, which came upon him with the force of a torrent, did not, however, wholly overpower him; he was indeed obliged to conceal himſelf, in order to avoid the rage of the populace: but he had ſtill confidence enough to offer an apology for his conduct, which poſſeſſed no inconſiderable ſhare of wit and humour, well tempered with ſpirit and maſterly reaſoning. It was not, however, of any conſequence to him; for he was baniſhed to Toro, where, worn out by infirmities, or overcome by deſpair, he ended his days about the year 1645.

Olivarez ‖ Olive Preſs.

OLIVE, the fruit of the olive tree. See OLEA, BOTANY *Index*.

OLIVE Preſs. In order to obtain the olive oil, the olives are firſt bruiſed in a rough trough, under a mill-ſtone, rolling perpendicularly over them; and when ſufficiently maſhed, put into the maye or trough, *m*, of an olive preſs, where *aa* are the upright beams, or cheeks; *b*, the female, and *c*, the male ſcrew; *f*, the board on which the ſcrew preſſes; *g*, a cubical piece of wood, called a *block*; *h*, the peel, a circular board, to be put under the block. By turning the ſcrew, all the liquor Plate CCCLXXX.

liquor is pressed out of the mashed olives, and is called *virgin oil;* after which, hot water being poured upon the remainder in the press, a coarser oil is obtained. Olive oil keeps only about a year, after which it degenerates.

OLIVE Colour, a yellow mingled with black.

OLIVET, or *Mount of OLIVES*, in *Ancient Geography*, was situated to the east of the city of Jerusalem, and parted from the city only by the brook Kidron, and by the valley of Jehoshaphat, which stretches out from the north to the south. It was upon this mount that Solomon built temples to the gods of the Ammonites (1 Kings xi. 7.) and of the Moabites, out of complaisance to his wives, who were natives of these nations. Hence it is that the mount of Olives is called the *mountain of corruption* (2 Kings xxiii. 13.). Josephus says, that this mountain is at the distance of five stadia, or furlongs, from Jerusalem, which make 625 geometrical paces, or the length of a Sabbath-day's journey, says St Luke (Acts i. 12.). The mount of Olives had three summits, or was composed of three several mountains, ranged one after another from north to south. The middle summit is that from whence our Saviour ascended into heaven. It was upon that towards the south that Solomon built temples to his idols. The summit which is most to the north is distant two furlongs from the middlemost. This is the highest of the three, and is commonly called Galilee.

In the time of King Uzziah, the mount of Olives was so shattered by an earthquake, that half of the earth that was on the western side fell down, and rolled four furlongs or 500 paces from thence, towards the mountain which was opposite to it on the east; so that the earth blocked up the highways, and covered the king's gardens.

Mr Maundrell tells us that he and his company going out of Jerusalem at St Stephen's gate, and crossing the valley of Jehoshaphat, began immediately to ascend the mountain; that being got above two-thirds of the way up, they came to certain grottoes cut with intricate windings and caverns under ground, which were called the sepulchres of the prophets; that a little higher up were twelve arched vaults under ground, standing side by side, and built in memory of the apostles, who are said to have compiled their creed in this place; that 60 paces higher they came to the place where Christ is said to have uttered his prophecy concerning the final destruction of Jerusalem; and a little on the right hand, to another, where he is said to have dictated a second time the Lord's prayer to his disciples; that somewhat higher is the cave of a saint called *Pelagia;* a little above that, a pillar denoting the place where an angel gave the Blessed Virgin three days warning of her death; and at the top of all, the place of our blessed Lord's ascension.

OLIVETAN, ROBERT, related to the famous Calvin, printed at Neufchatel in 1535, in folio, a version of the Bible into French, the first which had been translated from the original Hebrew and Greek. It is written in an uncouth and barbarous style, and is far from being faithful. The characters in which it is printed are Gothic, and the language of it is no less so. It is valued only because it is rare. Calvin is thought to have had a very considerable share in this translation. Olivetan survived his publication but a short time; for he was poisoned at Rome the year after, of which his translation is alleged to have been the cause. Olivetan's Bible, revised by John Calvin and N. Malinger, was reprinted at Geneva, in 1540, in quarto. This edition is still rarer than the former. It is called the *Bible de l'Epee*, because the printer had a sword for his sign.

OLIVIER, CLAUDE MATTHIEU, advocate of the parliament of Aix, was born at Marseilles in 1701, and appeared at the bar with eclat. He had a chief hand in the establishment of the academy of Marseilles, and was one of its original members. He possessed a quick and lively genius. A few hours retirement from society and from his pleasures were frequently sufficient to enable him to speak and write, even on important causes; but his works commonly bore marks of haste. Given to excess in every thing, he would employ a fortnight in studying the Code and the Digest, or in storing his mind with the beauties of Demosthenes, Homer, Cicero, or Bossuet; and then abandon himself for another fortnight, frequently a whole month, to a life of frivolity and dissipation. He died in 1736, at the age of 35. He published, 1. *L'Histoire de Philippe roi de Macedoine, et pere d'Alexandre le Grand*, 2 vols 12mo. No writer has so ably handled the history of the age of Philip, the interests of the different nations of Greece, and their manners and customs: but the conduct of the work is extremely defective. The digressions are too frequent, and often tedious. The style is in no respect suitable to a history. It is in general dry, unconnected, and like the style of a dissertation. Sometimes, however, we find in it passages full of fire and beauty, and turns of expression truly original. A disease of the brain, with which he was attacked, and under which he laboured several years, prevented him from putting his last hand to the work. 2. *Mémoire sur les secours donnés aux Romains par les Marseillois pendant la 2de Guerre Punique.* 3. *Mémoire sur les secours donnés aux Romains par les Marseillois durant la Guerre contre les Gaulois.*

OLMUTZ, a town of Germany, in Moravia, with a bishop's see, and a famous university. The public buildings are very handsome, particularly the Jesuits college. It is a populous, trading, and very strong place; and yet it was taken, with the whole garrison, by the king of Prussia in 1741. In July 1758 he besieged it again; and when he had almost taken the place he was obliged to raise the siege, to go and meet the Russian army. It is seated on the river Morave. E. Long. 17. 35. N. Lat. 49. 30.

OLYMPIA, MALDACHINI DONNA, a woman of a very uncommon character. She flourished about the middle of the 17th century. She was sister-in-law to Pope Innocent X. and had the address to acquire an unlimited power over this vain, weak, and injudicious ecclesiastic. Her son Camillo was promoted to the cardinalate, under the title of Pamphilio; but falling in love with the princess Rossana, a beautiful young widow, he laid aside his hat, and married. The crime, if it was one, was esteemed by the Romans in general at least venial. The pope, however, was displeased; and Olympia procured their banishment, being afraid lest her daughter-in-law should lessen her authority in the *sacred court.* This authority, equally unnatural and uncommon, reflected neither honour on her who held it, nor on the man who allowed her to hold it. Such elevated situations, Olympia.

situations, however, whether they are the reward of merit, the effect of chance, or acquired by cunning, are seldom very secure. Olympia, who had procured the disgrace of many who did not deserve it, and who had herself long merited such a fate, at length experienced both disgrace and banishment. This was obtained by means of Cardinal Panzirollo, a great favourite of the pope's. The immediate cause of it was this: The pope had determined, in order to lessen his own trouble, to adopt a nephew, and to make him a *Cardinal Patron*, in order to give audience to ambassadors and ministers, and in his absence to preside at the council. For this purpose, at the recommendation of his favourite, his holiness make choice of Astalli, brother of the marquis Astalli, who had married a niece of Olympia. Olympia indeed was slightly consulted on the affair, and showed no disapprobation of the appointment. The pope, however, no sooner got him fixed in his new office, than he showed his own weakness by repenting of it. Olympia too was displeased, and by her solicitations procured the disgrace of Astalli, before had enjoyed either the honours or emoluments of his office. Panzirollo, however, soon managed matters so as to turn the scales: he prevailed on the pope again to countenance and honour Astalli; and, what was more, had influence sufficient to persuade him to disgrace Olympia, and to banish her the court. She had indeed abused her authority in a most scandalous manner, and had gained such an absolute ascendant over the pope, that in every thing his will had been subservient to her dictates.—Her avarice and ambition were unbounded: she disposed of all benefices, which were kept vacant till she fully informed herself of their value: she rated an office of 1000 crowns for three years, at one year's revenue, and if for life, at 12 years purchase, one half of which sum she required to be paid in advance: she gave audience upon public affairs, enacted new laws, abrogated those of former popes, and sat in council with Innocent, with bundles of memorials in her hands. It was generally said that they lived together in a criminal correspondence, and that she had charmed him by some secret incantation. In the Protestant countries the loves and intrigues of Innocent and Donna Olympia were represented upon the stage; and severe sarcasms were daily put into the hands of Pasquin at Rome.—As she had usurped such an absolute authority, the new cardinal nephew saw the necessity of ruining her credit; he therefore seconded the endeavours of Panzirollo.—He insinuated to the pope, that his reputation had suffered greatly among the Catholics by her scandalous proceedings, and that his nuncios were treated with disrespect and contempt at the courts of the emperor, France, and Spain. Upon these representations, Innocent at length, but with great reluctance, banished Olympia, and was reconciled to Prince Camillo and the princess Rossana; though some authors affirm that her banishment was no more than a political retreat, and that she still in private directed the affairs of the pope. A woman of Olympia's character, however, with such unbounded ambition, such an extravagant lust for power, and such an ambitious desire of wealth, and who had once possessed so great an ascendency over such a man as Innocent, was not to be so easily put off. She was banished in 1650; but in 1653, she again assumed the supreme direction of affairs just as before her disgrace. She again accomplished the disgrace of Astalli, and procured the promotion of Azzolini to the office of secretary of the briefs. In 1654, his holiness resigned himself entirely into the hands of this assuming woman; who, observing his infirmities daily increasing, redoubled her rapacity, disposing of benefices to the highest bidders in all parts of Italy. She was again, however, in hazard of being displaced by a new favourite, viz. the cardinal de Retz; and had not the pope's dissolution prevented it, it would in all probability quickly have taken place. During his last illness he received nothing but from the hands of Donna Olympia, who was at great pains to prolong his life, watched continually at his bed side, and prevented the ambassadors or others from disturbing him with discourses upon business. She is said, during the last ten days of his life, when he continued without the use of reason, to have amassed about half a million of crowns. She did not find the succeeding pope (Alexander VII.) so easy to be played upon as his weak predecessor: a number of memorials were sent in against her, and his holiness was well disposed to attend to them: he ordered her to retire from Rome, and at the same time began to examine witnesses respecting her conduct. She was cut off, however, before the trial was finished, by the plague, which, in 1636, afflicted Rome and its neighbourhood. Her estate was not confiscated as was generally expected; and the prince Pamphilio was allowed to succeed her. The pope only reserved for his own relations about a million of crowns.

Olympia.

Olympia, in *Ancient Geograpy*, with the surname *Pisatis* (Strabo); so called from the territory of Pisa in Elis; described by Strabo, "as the temple of Jupiter Olympius, before which stands a grove of wild olive trees, in which is the stadium, or foot-course, so called because the eighth part of a mile; and by which the Alpheus, coming down from Arcadia, runs." Olympia, however, was famous not merely for the temple of Jupiter, but also for a temple of Juno, 63 feet long, with columns round it of the Doric order; and a Metroum or temple of the mother of the gods, a large Doric edifice; with holy treasuries. These, and the porticoes, a gymnasium, prytaneum, and many more buildings, chiefly in the enclosure, with the houses of the priests and other inhabitants, made Olympia no inconsiderable place. The stadium was in the grove of wild olive trees, before the great temple; and near it was the hippodrome or course for the races of horses and chariots. The Alpheus flowed by from Arcadia with a copious and very pleasant stream, which was received on the coast by the Sicilian sea.

The temple of Jupiter was of the Doric order, 68 feet high to the pediment, 95 wide, and 230 long; the cell encompassed with columns. It was erected with the country stone; the roof not of earth baked, but of Pentelic marble; the slabs disposed as tiles; the way to it up a winding staircase. The two pediments were enriched with sculpture; and one had over the centre a statue of Victory gilded; and underneath a votive buckler of gold. At each corner was a gilded vase. Above the columns were fixed 21 gilded bucklers, offered at the conclusion of the Achæan war by the Roman general Mummius. The gates in the two fronts were

Olympia, Olympiad. were of brafs, and over them were carved the labours of Hercules. Within the cell were double colonnades, between which was the approach to the image.

The Jupiter of Olympia was accounted alone fufficient to immortalize its maker, Phidias. It was of ivory and gold, the head crowned with olive. In the right hand was a ftatue of Victory; in the left a flowered fceptre, compofed of various metals, on which was an eagle. The fandals were of gold, as alfo the veftment, which was curioufly emboffed with lilies and animals. The throne was gold inlaid with ebony and ivory, and ftudded with jewels, intermixed with paintings and exquifite figures in relievo. The pillars between the feet contributed to its fupport. Before it were walls, ferving as a fence, decorated principally with the exploits of Hercules; the portion oppofite to the door of a blue colour. It was the office of a family defcended from Phidias, called *phædruntæ* or *the polifhers*, to keep the work bright and clean. The veil or curtain was cloth rich with the purple dye of Phœnicia and with Affyrian embroidery, an offering of King Antiochus, and was let down from above by loofening the ftrings. The image impreffed on the fpectator an opinion that it was higher and wider than it meafured. Its magnitude is fuch, that though the temple was very large, the artift feemed to have erred in the proportions. The god, fitting, nearly touched the ceiling with his head; fuggefting an idea, that if he were to rife up, he would deftroy the roof. A part of the pavement before it was of black marble, enclofed in a rim of Parian or white, where they poured oil to preferve the ivory,

The altar of Jupiter Olympius was of great antiquity, and compofed of afhes from the thighs of the victims, which were carried up and confumed on the top with wood of the white poplar tree. The afhes alfo of the prytaneum, in which a perpetual fire was kept on a hearth, were removed annually on a fixed day, and fpread on it, being firft mingled with water from the Alpheus. The cement, it was affirmed, could be made with that fluid only; and therefore this river was much refpected, and efteemed the moft friendly of any to the god. On each fide of the altar were ftone fteps. Its height was 22 feet. Girls and women, when allowed to be at Olympia, were fuffered to afcend the bafement, which was 125 feet in circumference. The people of Elis facrificed daily, and private perfons as often as they chofe.

Religion flourifhed at Olympia, and many deities were worfhipped befides Jupiter. Paufanias has enumerated above 60 altars of various fhapes and kinds. One of the unknown gods ftood by the great altar. The people of Elis offered on all thefe monthly; laying on them boughs of olive; burning incenfe, and wheat mixed with honey; and pouring libations of fuch liquors as the ritual prefcribed. At the latter ceremony fometimes a form of prayer was ufed, and they fung hymns compofed in the Doric dialect.

Olympia was fituated on an eminence, between two mountains called *Offa* and *Olympus*. Though its ancient fplendour is gone, the place reminds the traveller of what it once was. It is in the Morea, being now a fmall place called *Longinico*, 50 miles fouth of Lepanto, in E. Long. 22. 0. N. Lat. 37. 40.

OLYMPIAD, the fpace of four years, whereby the Greeks reckoned time.—The firft Olympiad fell, according to the accurate and learned computation of fome of the moderns, exactly 776 years before the firft year of Chrift, or 775 before the year of his birth, in the year of the Julian period 3938, and 22 years before the building of the city of Rome. The games were exhibited at the time of the full moon next after the fummer folftice; therefore the Olympiads were of unequal length, becaufe the time of the full moon differs 11 days every year, and for that reafon they fometimes began the next day after the folftice, and at other times four weeks after. The computation by Olympiads ceafed, as fome fuppofe, after the 304th, in the year 440 of the Chriftian era. It was univerfally adopted not only by the Greeks, but by many of the neighbouring countries; though ftill the Pythian games ferved as an epoch to the people of Delphi and to the Bœotians; the Nemæan games to the Argives and Arcadians; and the Ifthmian to the Corinthians and the inhabitants of the Peloponnefian ifthmus. To the Olympiads hiftory is much indebted. They have ferved to fix the time of many momentous events; and indeed before this method of computing time was obferved, every page of hiftory is moftly fabulous, and filled with obfcurity and contradiction, and no true chronological account can be properly eftablifhed and maintained with certainty.

Olympiad ‖ Olympic Games.

OLYMPIAS, a celebrated woman, who was daughter of a king of Epirus, and who married Philip king of Macedonia, by whom fhe had Alexander the Great. Her haughtinefs, and more probably her infidelity, obliged Philip to repudiate her, and to marry Cleopatra, the niece of King Attalus. Olympias was fenfible of this injury, and Alexander fhowed his difapprobation of his father's meafures, by retiring from the court to his mother. The murder of Philip, which foon followed this difgrace, and which fome have attributed to the intrigues of Olympias, was productive of the greateft extravagancies. The queen paid the greateft honour to her hufband's murderer. She gathered his mangled limbs, placed a crown of gold on his head, and laid his afhes near thofe of Philip. The adminiftration of Alexander, who had fucceeded his father, was in fome inftances offenfive to Olympias; but when the ambition of her fon was concerned, fhe did not fcruple to declare publicly that Alexander was not the fon of Philip, but that he was the offspring of an enormous ferpent who had fupernaturally introduced himfelf into her bed. When Alexander was dead, Olympias feized the government of Macedonia; and, to eftablifh her ufurpation, fhe cruelly put to death Aridæus, with his wife Eurydice, as alfo Nicanor the brother of Caffander, with 100 leading men of Macedon, who were inimical to her intereft. Such barbarities did not long remain unpunifhed: Caffander befieged her in Pydna, where fhe had retired with the remains of her family, and fhe was obliged to furrender after an obftinate fiege. The conqueror ordered her to be accufed, and to be put to death. A body of 200 foldiers were ordered to put the bloody commands into execution, but the fplendour and majefty of the queen difarmed their courage; and fhe was at laft maffacred by thofe whom fhe had cruelly deprived of their children, about 316 years before the Chriftian era.

OLYMPIC GAMES, were folemn games among the ancient Greeks, fo called from Olympian Jupiter, to whom they were dedicated; and by fome faid to be firft

Olympic Games.

first instituted by him, after his victory over the sons of Titan; others ascribe their institution to Hercules, not the son of Alcmena, but one of much greater antiquity; others to Pelops; and others to Hercules the son of Alcmena. By whomsoever they were instituted, we know that, at a period rather early, they had fallen into disuse. The wars which prevailed among the Greeks, for a while, totally interrupted the religious ceremonies and exhibitions with which they had been accustomed to honour the common gods and heroes; but the Olympic games were restored on the following occasion. Amidst the calamities which afflicted or threatened Peloponnesus, Iphitus, a descendant of Oxylus, to whom the province of Eleia * had fallen in the general partition of the peninsula, applied to the Delphic oracle. The priests of Apollo, ever disposed to favour the views of kings and legislators, answered agreeably to his wish, that the festivals anciently celebrated at Olympia, on the Alpheus, must be renewed, and an armistice proclaimed for all the states willing to partake of them, and desirous to avert the vengeance of heaven. Fortified by this authority, and assisted by the advice of Lycurgus, Iphitus took measures, not only for restoring the Olympic solemnity, but for rendering it perpetual. The injunction of the oracle was speedily diffused through the remotest parts of Greece by the numerous votaries who frequented the sacred shrine. The armistice was proclaimed in Peloponnesus, and preparations were made in Eleia for exhibiting shows and performing sacrifices. In the heroic ages, feats of bodily strength and address were destined to the honour of deceased warriors; hymns and sacrifices were reserved for the gods: but the flexible texture of Grecian superstition, easily confounding the expressions of respectful gratitude and pious veneration, enabled Iphitus to unite both in his new institution.

* *Gillies's History of Greece.*

The festival, which lasted five days, began and ended with a sacrifice to Olympian Jove. The intermediate time was chiefly filled up by the gymnastic exercises, in which all freemen of Grecian extraction were invited to contend, provided they had been born in lawful wedlock, and had lived untainted by any infamous immoral stain. The preparation for this part of the entertainment was made in the gymnasium of Elis, a spacious edifice, surrounded by a double range of pillars, with an open area in the middle. Adjoining were various apartments, containing baths, and other conveniences for the combatants. The neighbouring country was gradually adorned with porticoes, shady walks and groves, interspersed with seats and benches; the whole originally destined to relieve the fatigues and anxiety of the candidates for Olympic fame; and frequented in later times, by sophists and philosophers, who were fond to contemplate wisdom, and communicate knowledge, in those delightful retreats. The order of the athletic exercises, or combats, was established by Lycurgus, and corresponded almost exactly to that described by Homer, in the 23d book of the Iliad, and eighth of the Odyssey. Iphitus, we are told, appointed the other ceremonies and entertainments; settled the regular return of the festival at the end of every fourth year, in the month of July; and gave to the whole solemnity that form and arrangement, which it preserved with little variation above a thousand years; a period exceeding the duration of the most famous kingdoms and republics of antiquity. Among the benefactors of Olympia, at a much later period, was reckoned Herod, who was afterwards king of Judæa. Seeing, on his way to Rome, the games neglected or dwindling into insignificance from the poverty of the Eleans, he displayed vast munificence as president, and provided an ample revenue for their future support and dignity.

The care and management of the Olympics belonged for the most part to the Eleans; who on that account enjoyed their possessions without molestation, or fear of war or violence. They appointed a certain number of judges, who were to take care that those who offered themselves as competitors should perform their preparatory exercises; and these judges, during the solemnity, sat naked, having before them a crown of victory, formed of wild olive, which was presented to whomsoever they adjudged it. Those who were conquerors were called *Olympionices*, and were loaded with honours by their countrymen. At these games women were not allowed to be present; and if any woman was found, during the solemnity, to have passed the river Alpheus, she was to be thrown headlong from a rock. This, however, was sometimes neglected; for we find not only women present at the celebration, but also some among the combatants, and some rewarded with the crown. The preparations for these festivals were great. No person was permitted to enter the lists, if he had not regularly exercised himself ten months before the celebration at the public gymnasium of Elis. No unfair dealings were allowed; whoever attempted to bribe his adversary was subjected to a severe fine; and even the father and relations were obliged to swear that they would have recourse to no artifice which might decide the victory in favour of their friends. No criminals, nor such as were connected with impious and guilty persons, were suffered to present themselves as combatants. The wrestlers were appointed by lot. Some little balls superscribed with a letter were thrown into a silver urn, and such as drew the same letter were obliged to contend one with the other. He who had an odd letter remained the last; and he often had the advantage, as he was to encounter the last who had obtained the superiority over his adversary. In these games were exhibited running, leaping, wrestling, boxing, and the throwing of the quoit, which was called altogether πενταθλον, or *quinquertium*. Besides these, there were horse and chariot races, and also contentions in poetry, eloquence, and the fine arts. The only reward that the conqueror obtained was a crown of olive. This, as some suppose, was in memory of the labours of Hercules, which were accomplished for the universal good of mankind, and for which the hero claimed no other reward but the consciousness of having been the friend of mankind. So small and trifling a reward stimulated courage and virtue, and was the source of greater honours than the most unbounded treasures. The statues of the conquerors, called *Olympionicæ*, were erected at Olympia in the sacred wood of Jupiter.

Their return home was that of a warlike conqueror; they were drawn in a chariot by four horses, and everywhere received with the greatest acclamations. Their entrance into their native city was not through the gates: to make it more grand and more solemn, a breach was made in the walls. Painters and poets were employed in celebrating their names; and indeed the victories

victories severally obtained at Olympia are the subjects of the most beautiful odes of Pindar. The combatants were naked. A scarf was originally tied round their waist; but when it had entangled one of the adversaries, and been the cause that he lost the victory, it was laid aside, and no regard was paid to decency. The Olympic games were observed every fifth year, or, to speak with greater exactness, after a revolution of four years, and in the first month of the fifth year, and they continued for five successive days. As they were the most ancient and most solemn of all the festivals of the Greeks, it will not appear wonderful, that they drew so many people, not only inhabitants of Greece, but of the neighbouring islands and countries.

Such is the account of Grecian writers, who have, doubtless, often ascribed to positive institution many inventions and usages naturally resulting from the progressive manners of society. When we come to examine the Elean games in their more improved state, together with the innumerable imitations of them in other provinces of Greece, there will occur reasons for believing, that many regulations, referred by an easy solution to the legislative wisdom of Iphitus or Lycurgus, were introduced by time or accident, continued through custom, improved by repeated trials, and confirmed by a sense of their utility *. Yet such an institution as the Olympiad, even in its least perfect form, must have been attended with manifest advantages to society. It is sufficient barely to mention the suspension of hostilities which took place, not only during the celebration of the festival, but a considerable time both before and after it. Considered as a religious ceremony, at which the whole Grecian name was invited, and even enjoined, to assist, it was well adapted to facilitate intercourse, to promote knowledge, to soften prejudice, and to hasten the progress of civilization and humanity. Greece, and particularly Peloponnesus, was the centre from which the adventurous spirit of its inhabitants had diffused innumerable colonies through the surrounding nations. To these widely separated communities, which, notwithstanding their common origin, seemed to have lost all connexion and correspondence, the Olympiad served as a common bond of alliance and point of re-union. The celebrity of this festival continually attracted to it the characters most distinguished for genius and enterprise, whose fame would have otherwise been unknown and lost in the boundless extent of Grecian territory. The remote inhabitants, not only of European Greece, but of Asia and Africa, being assembled to the worship of common gods, were formed to the sense of a general interest, and excited to the pursuit of national honour and prosperity. Strangers of similar dispositions might confirm in Elis the sacred and indissoluble ties of hospitality. If their communities were endangered by any barbarous power, they might here solicit assistance from their Grecian brethren. On other occasions they might explain the benefits which, in peace or war, their respective countries were best qualified to communicate. And the Olympic festival might thus serve the purpose of resident ambassadors, and other institutions alike unknown to antiquity.

* *Gillies's History of Greece.*

OLYMPUS, the name of several mountains.—One bounding Bithynia on the south.—Another in the island of Cyprus, on whose top was a temple of Venus, which women were not permitted either to enter or to see (Strabo).—A third, Olympus of Galatia (Livy).—A fourth, of Lycia, with a noble cognominal town, near the sea coast (Strabo, Cicero), extinct in Pliny's time, there remaining only a citadel: the town was destroyed by P. Servilius Isauricus (Florus), having been the retreat of pirates. From this mountain there was an extensive prospect of Lycia, Pamphilia, and Pisidia (Strabo).—A fifth, Olympus of Mysia (Ptolemy); thence surnamed *Olympena*, anciently *Minor;* one of the highest mountains, and surnamed *Mysius* (Theophrastus;) situated on the Propontis, and thence extending more inland.—A sixth, on the north of Thessaly, or on the confines of Macedonia; famous for the fable of the giants (Virgil, Horace, Seneca); reckoned the highest in the whole world, and to exceed the flight of birds (Apuleius), which is the reason of its being called *heaven*, than which nothing is higher: the serenity and calmness which reign there are celebrated by Homer, Lucan, and Claudian.

OLYRA, a genus of plants belonging to the monœcia class; and in the natural method ranking under the 4th order, *Gramina*. See BOTANY *Index*.

OMAR EBN AL KHATTAB, successor of Abu Becr.—The Mohammedan imposture, like every other falsehood of its kind, copies after the truth as far as was thought convenient or proper; and miracles being the grand proof of revelation, it was to be expected that all pretences to that should assume at least the appearances of them. Few systems of faith are more absurd than Mohammed's; yet, though he disclaimed miracles, it was supported, as we are told by latter writers, by a variety of them, which, however, unfortunately for the creed they were contrived to support, are too trifling, absurd, and contradictory, to deserve the smallest attention.

They tell us, but upon grounds too vague and indeterminate to command belief, that Omar was miraculously converted to this faith: a man he is reported to have been, before this event, truly respectable, and in particular a violent opposer of the Arabian prophet. Mohammed, it seems, felt this opposition, and regretted it; he therefore, with the fervour, and, as it happened, with the success of a true prophet, according to his followers account, prayed for the conversion of this his dangerous antagonist. Omar, it is said, had no sooner read the 20th chapter of the Koran than he was convinced: upon which he instantly repaired to Mohammed and his followers, and declared his conversion. It is said, that at one time he intended to murder the prophet; and various causes are assigned for the prevention of this shocking piece of sacrilege. After his wonderful conversion, the Mohammedan writers inform us that he was surnamed *Al Faruk*, or the "divider;" because, say they, when a certain Moslem was condemned by Mohammed for his iniquitous treatment of a Jew, and appealed afterwards from the sentence of the prophet to Omar, he cut him in two with his scimitar, for not acquiescing in the decision of so upright a judge: which circumstance when Mohammed heard, he gave him the surname of *Al Faruk*, or "the divider;" because, by this action, he had shown himself capable of perfectly distinguishing between truth and falsehood. Al Kodai affirms, that 39 of Omar's adherents followed his example the same day he professed himself a votary of Mohammed.

Omar. The converſion of Hamza and Omar Ebn Al Khattab happened in the year preceding the firſt flight of the Moſlems into Ethiopia, or the fourth year of Mohammed's miſſion, according to Abulfeda. He was unqueſtionably a great acquiſition to the prophet, and enabled him to carry on his ſchemes to far more purpoſe than he could poſſibly have done without him, or if he had continued his enemy. Omar at length found his ſervices in the cauſe he had undertaken ſufficiently honoured and amply rewarded; for on the death of Abu Becr, who had ſucceeded the impoſtor himſelf, he was promoted to the regal and pontifical dignity. The title firſt aſſigned him was the *caliph of the caliph of the apoſtle of God;* or in other words *the ſucceſſor of the ſucceſſor of Mohammed:* but the Arabs conſidering that this title, by the addition to be annexed to it at the acceſſion of every future caliph, would be too long, they, by univerſal conſent, ſaluted him *the emperor of the believers;* which illuſtrious title, at this juncture conferred on Omar, deſcended afterwards to all the ſucceſſors of that prince. Our readers will not expect us to follow the caliph with minute exactneſs through the tranſactions of his reign. This would indeed ſwell our article beyond all proportion. We ſhall therefore confine ourſelves to ſome of the leading facts.

His arms appear to have been particularly ſucceſsful; the Perſians he conquered, and Jeruſalem ſubmitted to his power; nor does he appear to have been checked in a ſingle inſtance. In conſequence, however, of his ſucceſs, an attempt was made to aſſaſſinate him. The fact is thus related: Wathek Ebn Moſafer, a reſolute young Arab, was procured by the king of Ghaffan, and ſent to Medina for this very purpoſe. Some time after his arrival, obſerving Omar to fall aſleep under a tree on which he had placed himſelf, ſo as not to be diſcovered by any perſon, he drew his dagger, and was upon the point of ſtabbing him, when, lifting up his eyes, he ſaw a lion walking round about him, and licking his feet. Nor did the lion ceaſe to guard the caliph till he awoke; but then inſtantly went away. This phenomenon ſtruck Wathek with a profound reverence for Omar, whom he now revered as the peculiar care of heaven. He therefore came down from the tree, on which the lion had forced him to remain, kiſſed the caliph's hand, confeſſed his crime, and embraced the Mohammedan religion; being ſo ſtrongly affected with the wonderful deliverance he had been an eye witneſs of. His life, however, was at length ended by aſſaſſination; for about two years after the concluſion of the Nohawandian war, in which the Arabs probably ſtill farther extended their conqueſts, though no account of their military operations during that period has reached us, that is, in the 23d year of the Hegira, according to Abu Jaafar Al Tabari, the caliph Omar Ebn Al Khattab was aſſaſſinated by a Perſian ſlave; of which horrid fact the Arab writers have handed down the following particulars: Abu Lulua, a Perſian of the Magian ſect, whoſe name was *Firuz*, one of Al Mogheira Ebn Al Shaabah's ſlaves, was obliged by his maſter to pay daily two dirhems, in conformity to the Mohammedan cuſtom, for the free exerciſe of this religion. Firuz reſenting this treatment, complained of it to the caliph, and deſired that ſome part at leaſt of the tribute exacted of him might be remitted; but this favour being refuſed by Omar, the Perſian threatened his deſtruction; which he ſoon after effected, by ſtabbing him thrice in the belly with a dagger, while he was in the moſque at Medina performing his morning devotions. The Arabs then preſent perceiving that the villain had imbrued his hands in the blood of their ſovereign, immediately ruſhed upon him; but he made ſo deſperate a defence, that he wounded 13 of the aſſailants, and ſeven of them mortally. At laſt one of the caliph's attendants threw his veſt over him, and ſeized him; upon which he ſtabbed himſelf and ſoon after expired. According to Theophanes, this Firuz was an apoſtate or renegade, and conſequently had before embraced the Mohammedan religion: but this aſſertion is by no means probable; becauſe on his becoming a convert to Iſlamiſm, he muſt have been manumitted by his maſter, and on his relapſing into Magiiſm, he would have been put to death by the caliph's order: neither of which particulars are conſiſtent with what we find related by the Arab hiſtorians, and even by our Greek chronographer himſelf. Omar languiſhed three days and then died, in the month of Dhu'lhajja, and the 23d year of the Hegira, which began in the year of our Lord 643. Authors are not agreed with regard to the duration of his caliphate. The Arab hiſtorians, whom we are inclined to follow, ſay that he reigned between 10 and 11 years. Theophanes affirms, that he was murdered in the 12th year of his caliphate, and Dionyſius Telmarenſis extends the length of his reign to 12 complete years. Only one of the wounds given him by Firuz was mortal, and that he received under his navel. At his death he was 63 years old; which, as we are told by an Arab author, was the age of Mohammed himſelf, Abu Becr, and Ayeſha, one of the prophet's wives, when they died. When Omar fell in the moſque, Abd'alrahman Ebn Awf, one of Mohammed's firſt converts, ſupplied his place during the remainder of the ſervice; and three days before his death, Sahib Ebn Tarſib, at his command, officiated for him. His body was interred in Ayeſha's apartment, near that of the prophet Mohammed. We are informed by Eutychius, that during his caliphate he performed the pilgrimage to Mecca nine times. His extenſive conqueſts made the Moſlem empire one of the moſt powerful and formidable monarchies in the world. His diſpoſition is repreſented to us, with evident partiality indeed, as one of the beſt poſſible, and his temperance has always been highly extolled.

Omar, Ombi. OMBI, a city of ancient Egypt, afterwards called *Arſinoe* and *Crocodilopolis*, was the capital of one of the nomes into which that country was divided, and is remarkable, in the annals of idolatry, for the hatred of its inhabitants to the religion of their neighbours the citizens of Tentyra.

The genius of paganiſm was ſo complying with reſpect to the objects of religious worſhip, that although each nation, each city, and almoſt every family, had its own tutelar god, we know not a ſingle inſtance, out of Egypt, of one tribe of Pagans perſecuting another for worſhipping gods different from theirs. The Jews and Chriſtians were indeed perſecuted by the Romans, not however for worſhipping the true God, but becauſe, together with him, they would not worſhip Jupiter, Juno, and all the rabble of heathen divinities.

The reaſon of the almoſt univerſal tolerance of idolaters to one another, and of the intolerance of all to the

Ombi, Ombre.

the Jews and Christians, is very obvious. Not a single Pagan, a very few philosophers perhaps excepted, ever thought of paying his adoration to the Supreme and self-existent Being, but to inferior divinities, to whom it was supposed that the care of particular persons, families, cities, and nations was consigned by the God of the universe. The consequence was, that, as no person denied the divinity of his neighbour's object of worship, an intercommunity of gods was everywhere admitted, and all joined occasionally in adoring the gods of the various nations. By the Jews and Christians this communion was rejected as in the highest degree impious; and it could not well be maintained between the citizens of Ombi and those of Tentyra.

That brutes were worshipped in Egypt is universally known (See POLYTHEISM); and Diodorus the Sicilian informs us, in a passage quoted by Eusebius *, that "the cities and nomes of Egypt being at one time prone to rebellion, and to enter into conspiracies against monarchical government, one of their most politic kings contrived to introduce into the neighbouring nomes the worship of different animals; so that while each reverenced the deity which itself held sacred, and despised that which its neighbours had consecrated, they could hardly be brought to join cordially in one common design to the disturbance of the government."

* *Prep. Evang.* p. 32 Steph. ed.

In this distribution of gods he conferred upon Ombi the *crocodile*, and upon Tentyra, the mortal enemy of that monster, the *ichneumon*. The consequence of which was, that while the Ombites worshipped the crocodile, the Tentyrites took every opportunity of slaughtering him, insomuch that, according to Strabo, the very voice of an inhabitant of Tentyra put the crocodile to flight. This, we confess, is a very improbable fact; but it is certain that the mutual hatred of those cities, on account of their hostile gods, rose to such a height, that whenever the inhabitants of the one were engaged in the more solemn rites of their religion, those of the other were sure to embrace the opportunity of setting fire to their houses, and rendering them every injury in their power to inflict. And what may, to a superficial thinker, appear extraordinary, though it will excite no wonder in the breast of him who has studied mankind, this animosity continued between the inhabitants of the two cities long after the crocodile and ichneumon had lost their divinity.

The conduct of the Egyptian monarch was admirably calculated for preventing the nation from combining against the government; and it extended its influence over the whole kingdom. Diodorus informs us, that he assigned to each nome an animal to worship, which was hated, killed, and sometimes fed upon by the inhabitants of the neighbouring nome; and we know upon higher authority than his, that the Israelites could not offer sacrifices in Egypt, because the bullock was deemed sacred over the whole country.

OMBRE, a celebrated game at cards, borrowed from the Spaniards, and played by two, by three, or by five persons, but generally by three. When three play at this game, nine cards are dealt to each party; the whole ombre pack being only 40: because the eights, nines, and tens, are thrown out of the pack. There are two sorts of counters for stakes, the greater and the lesser; the last having the same proportion to the other as a penny to a shilling: of the greater counters each man stakes one for the game; and one of the lesser for passing for the hand, when eldest, and for every card taken in. As to the order and value of the cards, the ace of spades, called *spadillo*, is always the highest trump, in whatsoever suit the trump be; the *manille*, or black duce, is the second; and the *basto*, or ace of clubs, is always the third: the next in order is the king, the queen, the knave, the seven, the six, the five, four, and three. Of the black there are 11 trumps; of the red, 12. The least small cards of the red are always the best, and the most of the black; except the duce and red seven, both of which are called the *manilles*, and are always second when the red is a trump. The red ace, when a trump, enters into the fourth place, and is called *punto*; otherwise it is only called an ace. The three principal cards are called *matadores*; which have this privilege, that they are not obliged to attend an inferior trump when it leads; but for want of a small trump, the person may renounce trumps, and play any other card; and when these are all in the same hand, the others pay three of the greater counters a-piece; and with these three for a foundation, he may count as many matadores as he has cards in an uninterrupted series of trumps; for all which the others are to pay one counter a-piece. He who hath the first hand is called *ombre*, and has his choice of playing the game, of naming the trump, and of taking in as many and as few cards as he pleases; and after him the second, &c. But if he does not name the trump before he looks on the cards he has taken in, any other may prevent him, by naming what trump he pleases. He that has the first hand should neither take in, nor play, unless he has at least three sure tricks in his hand: for, as he wins the game who wins most tricks, he that can win five of the nine has a sure game: which is also the case if he wins four, and can so divide the tricks as that one person may win two, and the other three.

If a person plays without discarding or changing any cards, this is called *playing sans prendre*; and if another win more tricks than he, he is said to *win codille*. The over-sights in the course of the game are called *beasts*. And if the ombre wins all the nine tricks, it is called *winning the vole*.

In ombre by five, which many, on account of its not requiring so close an attention, prefer to that by three, only eight cards a-piece are dealt; and five tricks must be won, otherwise the ombre is beasted. Here the person who undertakes the game, after naming the trump, calls a king to his assistance; upon which the person in whose hand the king is, without discovering himself, is to assist him as a partner, and to share his fate. If, between both, they can make five tricks, the ombre wins two counters, and the auxiliary king only one; but when the counters are even, they divide them equally. If the ombre venture the game without calling in any king, this too is called *playing sans prendre*; in which case the other four are all against him, and he must win five tricks alone, or be beasted. The rest is much the same as by three.

OMBRE *de soleil*, "Shadow of the sun," in *Heraldry*, is when the sun is borne in armory, so as that the eyes, nose, and mouth, which at other times are represented, do not appear; and the colouring is thin, so that the field can appear through it.

OMBRIA, the ancient name of a province of Italy, in the territory of the pope, now called *Spoletto* and *Perugia*.

OMBRO, or LOMBRO, a town of Italy, in the duchy of Tuscany, and territory of the Siennois, situated near the Tuscan sea, a little south of the lake of Castiglione, 45 miles south-west of Sienna.

OMBROMETER, an instrument to measure the quantity of rain that falls. We have the description and figure of one in Phil. Transf. N° 473. p. 12. It consists of a tin funnel, whose surface is an inch square, with a flat board, and a glass tube set into the middle of it in a groove. The rise of the water in the tube, whose capacity at different times must be measured and marked, shows the quantity of rain that has fallen.

OMELET, or AMLET, a kind of pancake or fricassee of eggs, with other ingredients, very usual in Spain and France. It may be made as follows: The eggs being beaten, are to be seasoned with salt and pepper, and then fried in butter made boiling hot; this done, gravy is to be poured on, and the whole stewed with chives and parsley shred small: when one side is fried enough, it is to be turned on the other.

OMEN, is a word which, in its proper sense, signifies a sign or indication of some future event, taken from the language of a person speaking without any intent to prophecy. Hence Tully says, "Pythagorei non solum voces deorum observarunt, sed etiam hominum, quæ vocent *omina*;" "the Pythagoreans attend to the discourse not only of gods, but also of men, which they call *omens*." This sort of omen was supposed to depend much upon the will of the person concerned in the event; whence the phrases *accepit omen, arripuit omen*. Such were the original *omens*; but they were afterwards derived from *things* as well as from words. Thus Paterculus, speaking of the head of Sulpicius on the rostrum, says it was *velut omen imminentis proscriptionis*, "the omen of an impending proscription." Suetonius says of Augustus, that he believed implicitly in certain omens; and that, *si manè sibi calceus perperam, ac sinister pro dextero induceretur, ut dirum*, "If his shoes were improperly put on in the morning, especially if the left shoe was put upon his right foot, he held it for a bad omen." Omen was used in a still larger sense, to signify an *augury*; as in the following line of Tully: "Sic aquilæ clarum firmavit Jupiter *omen*;" "thus Jove confirmed the bright omen of the eagle." It was lastly used, in the most generic sense of all, for a portent or prodigy; as in the third book of the Æneid, where a myrtle torn up by Æneas dropped blood. Upon this appearance, says the hero,

——— Mihi frigidus horror
Membra quatit, gelidusque coit formidine sanguis.

And the same thing being repeated upon his breaking a branch from another tree, he prayed to the gods to avert the *omen*.

Multa movens animo Nymphas venerabar agrestes,
Gradivumque patrem, Geticis qui præsidet arvis,
Rite secundarent visus, *omen*que levarent (A).

The portentous or supernatural omens were either external or internal. Of the former sort were those showers of blood so frequently occurring in the Roman history, which were much of the same nature with this adventure of Æneas, which he calls MONSTRA DEUM. Of the second sort were those sudden consternations, which, seizing upon men without any visible cause, were imputed to the agency of the god *Pan*, and hence called *panic fears*. But indeed there was hardly any thing, however trivial, from which the ancients did not draw omens. That it should have been thought a direful omen when any thing befel the temples, altars, or statues of the GODS, need excite no wonder; but that the meeting of a eunuch, a negro, a bitch with whelps, or a snake lying in the road, should have been looked upon as portending bad fortune, is a deplorable instance of human weakness, and of the pernicious influence of superstition on the mind.

It is more than probable that this practice of making ordinary events ominous of good or bad fortune took its rise in Egypt, the parent country of almost every superstition of paganism; but wherever it may have arisen, it spread itself over the whole inhabited globe, and at this day prevails in a greater or less degree among the vulgar of all nations.

In England, it is reckoned a good omen, or a sign of future happiness, if the sun shines on a couple coming out of the church after having been married. It is also esteemed a good sign if it rains whilst a corpse is burying:

Happy is the bride that the sun shines on;
Happy is the corpse that the rain rains on.

To

(A) Instead of translating these short quotations, we shall here give Dryden's version of the whole of this portentous adventure, as we are persuaded that the mere English reader, who alone can wish for a translation, will be glad to have the fullest account of the bleeding myrtle, together with its effects on the mind of the hero. It is as follows:

Not far, a rising hillock stood in view;
Sharp myrtles on the sides and corners grew.
There, while I went to crop the sylvan scenes,
And shade our altar with their leafy greens,
I pull'd a plant (with horror I relate
A prodigy so strange, and full of fate):
The rooted fibres rose; and from the wound
Black bloody drops distill'd upon the ground.
Mute and amaz'd, my hair with terror stood;
Fear shrunk my sinews, and congeal'd my blood.
Mann'd once again, another plant I try;
That other gush'd with the same sanguine dye.
Then, fearing guilt for some offence unknown,
With prayers and vows the Dryads I atone,
With all the sisters of the woods, and most
The god of arms, who rules the Thracian coast:
That they, or he, these omens would avert,
Release our fears, and better signs impart.

Omen.

To break a looking glafs is extremely unlucky; the party to whom it belongs will lofe his beft friend.

If, going a journey on bufinefs, a fow crofs the road, you will probably meet with a difappointment, if not a bodily accident, before you return home. To avert this, you muft endeavour to prevent her croffing you; and if that cannot be done, you muft ride round on frefh ground. If the fow is attended with her litter of pigs, it is lucky, and denotes a fuccefsful journey.

It is unlucky to fee firft one magpye, and then more; but to fee two, denotes marriage or merriment; three, a fuccefsful journey; four an unexpected piece of good news; five, you will fhortly be in a great company. To kill a magpye, will certainly be punifhed with fome terrible misfortune.

If, in a family, the youngeft daughter fhould be married before her elder fifters, they muft all dance at her wedding without fhoes: this will counteract their ill luck, and procure them hufbands.

If you meet a funeral proceffion, or one paffes by you, always take off your hat: this keeps all evil fpirits attending the body in good humour.

If, in eating, you mifs your mouth, and the victuals fall, it is very unlucky, and denotes approaching ficknefs.

It is lucky to put on a ftocking the wrong fide outwards: changing it alters the luck.

When a perfon goes out to tranfact any important bufinefs, it is lucky to throw an old fhoe after him.

It is unlucky to prefent a knife, sciffars, razor, or any fharp or cutting inftrument, to one's miftrefs or friend, as they are apt to cut love and friendfhip. To avoid the ill effects of this, a pin, a farthing, or fome trifling recompenfe, muft be taken. To find a knife or razor, denotes ill luck and difappointment to the party.

In the Highlands of Scotland, it is thought unlucky if a perfon fetting out upon a journey ftumble over the threfhold, or be obliged to return for any thing forgotten. If a fportfman fee any perfon ftepping over his gun or fifhing rod, he expects but little fuccefs in that day's diverfion. *Sneezing* is alfo deemed ominous. If one fneeze when making a bed, a little of the ftraw or heath is taken out and thrown into the fire, that nothing may difturb the reft of the perfon who is to fleep in the bed. Among the fame people, fuccefs in any enterprife is believed to depend greatly upon the firft creature that prefents itfelf after the enterprife is undertaken. Thus, upon going to fhoot, it is reckoned lucky to meet a horfe, but very unfortunate to fee a hare, if fhe efcape; and upon meeting any creature deemed unlucky, the beft means of averting the omen is to roll a ftone towards it. The Greeks attributed the fame efficacy to the rolling of a ftone, though they greatly preferred *killing* the ominous animal, that the evil portended might fall on its own head*.

The motions and appearances of the clouds were not long ago confidered as certain figns by which the fkilful Highlander might attain to the knowledge of futurity. On the evening before *new year's day*, if a black cloud appeared in any part of the horizon, it was thought to prognofticate a plague, a famine, or the death of fome great man in that part of the country over which it fhould appear to fet; and in order to afcertain the place threatened by the omen, the motions of this cloud were often watched through the whole night, if it happened to continue fo long vifible above the horizon.

* See *Potter's Antiquities*, vol. i. p. 346.

By the believers in this fuperftition there are days, as well as words and events, which are deemed ominous of good or bad fortune. The firft day of every quarter, midfummer, and new year's day, are reckoned the moft fortunate days in the year for accomplifhing any defign. In the ifle of Mull, ploughing, fowing, and reaping, are always begun on *Tuefday*, though the moft favourable weather for thefe purpofes be in this way frequently loft. That day of the week on which the third of May falls, is deemed unlucky throughout the whole year. In Morven, none will upon any account dig peat or turf for fuel on *Friday*; and it is reckoned unlucky to number the people or cattle belonging to any family, and doubly fo if the number be taken on Friday. The age of the moon is alfo much attended to by the vulgar Highlanders. It is alleged, that during the increafe things have a tendency to grow and ftick together: and hence, in the ifle of Sky, fences, which are there made of turf, are built only at that time; whilft turf or peat for fuel are never, even in the moft favourable weather, either made or ftacked up but while the moon is in its wane. An opinion prevails in fome places, that if a houfe take fire during the increafe of the moon, the family to which it belongs will profper in the world: but that if the fire happen while the moon is in the decreafe, the family will from that time decline in its circumftances, and fink into poverty.

In attributing fuch influence to the moon, the fuperftitious Highlanders have the honour to agree with the philofophic Virgil, who in his Georgics gives the following fage inftructions to the hufbandman:

Ipfa dies alios alio dedit ordine Luna
Felices, operum. Quintam fuge:
* * * *
Septima poft decimam felix et ponere vitem,
Et prenfos domitare boves, et licia telæ
Addere: nona fugæ melior, contraria furtis.

The lucky days in each revolving moon
For labour choofe: the *fifth* be fure to fhun.
* * *
The *feventh* is next the *tenth*, the beft to join
Young oxen to the yoke, and plant the vine.
Then weavers ftretch your ftays upon the weft:
The *ninth* is good for travel, bad for theft.

DRYDEN.

From this coincidence of the fuperftition of the Roman poet with that of the natives of Mull and Morven, we are ftrongly inclined to adopt the hypothefis of the gentleman who favoured us with this accurate account of Highland omens. He juftly obferves, that this fuperftitious practice of auguring good or ill from trifling events, and from the particular phafes of the moon, has no connexion whatever with popifh prieftcraft: he fhows that the Romifh clergy, even in the darkeft age, were at pains to eradicate it as idle and impious; and he therefore infers, that it muft be a relick of Druidifm handed down by tradition from an era prior to the introduction of Chriftianity into the Highlands and ifles of Scotland. That the Druids were

were acquainted with the particular doctrines of Pythagoras has been shown elsewhere (see DRUIDS); that Virgil was no stranger to the Pythagorean philosophy is known to every scholar; that Pythagoras and his followers were addicted to the dotages of MAGIC has been made apparent in that article; and therefore it appears to us probable at least, that the attention paid to pretended omens, not only in the Highlands, but also in the low country of Scotland, and indeed among the vulgar in every country of Europe, is a remnant of one of the many superstitions which the Druids imposed upon their deluded followers. That it is contrary to every principle of sound philosophy, all philosophers will readily acknowledge; and whoever has studied the writings of St Paul must be convinced that it is inconsistent with the spirit of genuine Christianity.

OMENTUM, or EPIPLOON, the *Cawl*, in *Anatomy*, a membranaceous part, usually furnished with a large quantity of fat; being placed under the peritonæum, and immediately above the intestines. See ANATOMY, N° 90.

OMER, in Jewish antiquity. See CORUS.

ST OMER's, a strong, fortified, large, and populous town of France, in the department of the straits of Calais, with a castle and a bishop's see. It is a fortress of considerable importance, and surrounded on one side with a large morass; and about it there are many sluices, which serve to carry the water off when it is overflowed; and in the midst of the morass there is a sort of floating islands covered with verdure and trees. The cathedral is a handsome structure; and there are other fine buildings, with a rich Benedictine abbey. The French became masters of this place in 1679. It is seated on the river Aa, and on the side of a hill, eight miles north-west of Aire, and 135 north of Paris. E. Long. 2. 20. N. Lat. 54. 45.

OMOA, a Spanish town and fortification on the south side of the bay of Honduras, N. Lat. 15. 50. W. Long. 89. 50. from London. It is the key to the bay; and such is the depth of the water, that ships of any burden may ride in the harbour with safety. It is a place of the utmost importance to Spain, as the register ships to and from Guatimala are sent to it in the time of war. The town was first established in 1751, under the command of Don Joseph Antonio de Palmo. At that period the inhabitants were about 20 white men, 60 mulattoes and free negroes, and 200 slaves to the king of Spain; and the military force consisted of about 30 soldiers, besides officers. The fort was originally composed of sand confined in boarded coffers, and faced with half-burnt bricks. It was defended by 12 fine brass 24 pounders mounted, four or five iron guns of different bores, and some field-pieces. The Spaniards, sensible of the importance of the place, afterwards fortified it at an incredible expence, the stone of which the walls are built having been raised from the sea, and brought from the distance of 20 leagues. The outworks were not completely finished in the year 1779, though 1000 men had then been employed upon them for 20 years.

Towards the end of that year an expedition was undertaken against this fortress, in consequence of one formed by the Spaniards against the British logwood cutters in the bay of Honduras and on the Mosquito shore. The latter, finding themselves hard pressed by their enemies, applied to General Dulling governor of Jamaica for assistance; who accordingly sent a detachment to their relief under Captain Dalrymple, with necessary supplies of arms, ammunition, and artillery. Before their arrival, however, the Spaniards had taken possession of St George's Key, the chief settlement of the British in these parts, which they plundered, and took a number of prisoners; but those who escaped, being joined by a body of their countrymen, retook it, and forced the enemy to retire. In the mean time Captain Dalrymple, who had been informed of the loss of the place, was hastening to the relief of the inhabitants, and in his way fell in with Admiral Parker, who was in quest of some register ships; but which, retreating into the harbour of Omoa, were too strongly protected by the fort there to be attacked by sea. As the Spaniards, however, had now been compelled to abandon St George's Key, it was proposed to unite the British forces by sea and land, and to attempt the conquest of this fortress. As the force under Captain Dalrymple was too inconsiderable to attempt the fort by land, it was augmented by the marines of the squadron and a strong party of the settlers; though, after all, it did not exceed the number of the garrison who opposed them.

The troops were landed at about nine miles distance from the fort in the dusk of the evening, with a design to march directly forward, in order to surprise and carry it by escalade in the night time. No roads, however, being found, they were obliged to explore their way through narrow foot-paths, morasses, and over mountains so beset with precipices, that they were obliged, in order to avoid them, to make use of lights made of the cabbage tree. In consequence of these impediments they were yet at a considerable distance from the fort, when the approach of day discovered them to the enemy. An engagement ensued, in which the Spaniards were quickly routed and driven into the town: from whence as they continued to fire upon the British, it was found necessary to set fire to it, though very much against the inclination of the assailants.

In the mean time the squadron took the opportunity, while the town was in flames, to come into the bay, and approach the fort with an intention to batter it; but the garrison returned the fire so briskly, that no impression could be made by that of the squadron, which was detained by want of wind from approaching sufficiently near. The troops then, being masters of the ground adjacent to the fort, erected several batteries in such situations as were most proper for annoying it; but though they carried on their operations with great vigour, it was still found that heavier artillery than any they possessed would be requisite, the walls being no less than 18 feet in thickness; in consequence of which they resolved still to attempt the place by escalade.

The attempt was made on the 21st of October, early in the morning. The troops entered the ditch, which fortunately for them happened to be dry, and fixed their scaling ladders against the walls, which were near 30 feet high. Two seamen mounted first; and, with admirable courage and presence of mind, stood by the ladder which they had mounted, to guard it till others ascended;

ed; and boldly presented their pieces against a large party drawn up to receive them, though they prudently retained their fire till their comrades came up.

The squadron, now drawing near, kept up a heavy and continual fire upon the fort, while the Spaniards were struck with such surprise at the excessive celerity and boldness of the assailants, that they remained motionless and unable to oppose their enemies, notwithstanding the exhortation and example of their officers. From this panic they never recovered; and while the seamen and soldiers continued to scale the walls with amazing quickness, the Spaniards never made any effort to defend themselves. About 100 of them escaped over the walls on the opposite side of the fort; the remainder surrendered at discretion.

The whole of this transaction reflected the highest lustre both on the conduct and courage of the British; and an instance of heroism is related in a British sailor to which history affords nothing superior. This man, having scaled the walls, had armed himself with a cutlass in each hand. Thus armed, he met with a Spanish officer unarmed, and just roused from sleep. The generous tar scorned to take advantage of his condition, and therefore presented him with one of his own cutlasses saying, "You are now on a footing with me!" The officer, however, was too much struck with admiration at his conduct to accept the offer, and took care to make the circumstance sufficiently known.—The value of the booty taken on this occasion amounted to three millions of dollars; but the loss most sensibly felt by the Spaniards was that of 250 quintals of quicksilver, a commodity indispensably necessary in extracting the precious metals from their ores. They offered therefore to ransom it at any price: but though the retention of it was far from affording a profit equal to that offered by the Spaniards, the British commanders absolutely refused to part with it, on account of the advantages the enemy would derive from having the metal in their possession. For the same reason they refused to accept of any ransom for the fort, though the governor offered to lay down 300,000 dollars for it. The Spanish military and the inhabitants were treated with the utmost humanity; their personal effects remaining untouched: and this generosity must have appeared to greater advantage, when contrasted with the behaviour of their own countrymen at Honduras, where the British were treated with remarkable severity. The church plate and ornaments were restored, on condition that the terms of capitulation should be faithfully kept.

In a short time, however, it appeared that it would have been better to have accepted of a ransom for the fort, as from circumstances at that time it could not be retained in the possession of Britain. A garrison was indeed left for its defence on the departure of the British squadron; but as it was very inconsiderable, on account of the small number of men that could be spared, the Spaniards quickly determined to make an attempt to regain the fort. For this purpose a body of 2000 men were collected, who invested it on the 25th of November. The British defended it with the utmost bravery; keeping up a constant fire on the enemy, and obliging them to retire for shelter, and take up their quarters behind a hill. Here they made preparations for an assault, in which their numbers left the success, as they supposed, by no means dubious. The garrison was therefore summoned to surrender, with a promise of the honours of war and a safe conveyance to Great Britain, denouncing at the same time the utmost vengeance in case of a refusal; which being refused, the necessary preparations were made for an escalade.

The condition of the garrison was now such as could afford very little hope of being able to make any effectual resistance. They were but 85 in number, most of whom were become incapable of duty either from illness or excessive fatigue. They were now also obliged to make one centinel answer for five, by shifting his place, and challenging as many times. There was no surgeon to attend the sick and wounded; nor had they even any water but what came from a sloop of war that lay abreast of the fort. In this desperate situation, they resolved, notwithstanding the menaces of the Spanish commander to render the place as unserviceable as they could. For this purpose they spiked up all the guns; destroying the stores and ammunition that could not be carried off: they even locked the gates of the fort, after which they embarked without the loss of a single man. All this was performed in defiance of the large force that besieged them; and the exploit, when duly considered, must appear not less a matter of astonishment than the extraordinary manner in which the fort had been taken. The officer who commanded in this remarkable retreat was Captain Hulke of the navy.

OMOPHAGIA, an ancient Greek festival, in honour of Bacchus, surnamed *Omophagos*, i. e. eater of raw flesh. This festival was observed in the same manner with the other festivals of Bacchus, in which they counterfeited madness. What was peculiar to it, was, that the worshippers used to eat the entrails of goats, raw and bloody, in imitation of the god, who was supposed to do the same thing.

OMPHACINE OIL, a viscous brown juice extracted from green olives. With this oil the ancient *athletæ*, when going to wrestle, anointed themselves; and when that gymnastic exercise was over, they rolled themselves in the sand, which, mixing with the oil and sweat on their bodies, constituted the *strigmenta* so highly esteemed in the cure of several diseases. This precious medicine was carefully scraped off the body of the athleta with a kind of instrument something like a comb, which was called *strigilis*; and such was the demand for the scrapings, that they were a very lucrative article of trade.

OMPHALE, in *Fabulous History*, a queen of Lydia, daughter of Jardanus. She married Tmolus, who at his death left her mistress of his kingdom. Omphale had been informed of the great exploits of Hercules, and wished to see so illustrious a hero. Her wish was soon gratified. After the murder of Eurytus, Hercules fell sick, and was ordered to be sold as a slave, that he might recover his health and the right use of his senses. Mercury was commissioned to sell him, and Omphale bought him, and restored him to liberty. The hero became enamoured of his mistress, and the queen favoured his passion, and had a son by him, whom some call Agelaus, and others Lamon. From this son were descended Gyges and Crœsus; but this opinion is different from the account which makes these Lydian monarchs

monarchs spring from Alcæus, a son of Hercules, by one of the female servants of Omphale. Hercules is represented by the poets as so desperately enamoured of the queen, that, to conciliate her esteem, he spins by her side among her women, while she covers herself with the lion's skin, and arms herself with the club of the hero, and often strikes him with her sandals, for the uncouth manner with which he holds the distaff, &c. Their fondness was mutual. As they once travelled together, they came to a grotto on Mount Tmolus, where the queen dressed herself in the habit of her lover, and obliged him to appear in a female garment. After they had supped, they both retired to rest in different rooms, as a sacrifice on the morrow to Bacchus required. In the night Faunus, or rather Pan, who was enamoured of Omphale, introduced himself into the cave. He went to the bed of the queen, but the lion's skin persuaded him that it was the dress of Hercules; and therefore he repaired to the bed of Hercules, in hopes to find there the object of his affections. The female dress of Hercules deceived him, and he laid himself down by his side. The hero was awakened, and kicked the intruder into the middle of the cave. The noise awoke Omphale, and Faunus was discovered lying on the ground, greatly disappointed and ashamed.

OMPHALEA, 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*.

OMPHALO-MESENTERIC, in *Anatomy*. All fœtuses are wrapped up in at least two coats or membranes; most of them have a third, called *allantoides*, or *urinary*.

Some, as the dog, cat, hare, &c. have a fourth, which has two blood-vessels, viz. a vein and an artery, called *omphalo-mesenterics*, because passing along the string to the navel, and terminating in the mesentery.

OMRAH, a man of the first rank in the Mogul empire; a nobleman. It is the plural of the Arabic *ameer*.

ON, in *Ancient Geography*, a city of Egypt sacred to the sun, and by the Greeks, on that account, called *Heliopolis*. (See HELIOPOLIS.) It was remarkable for the wisdom and learning of its priesthood, and for the spacious building in which they cultivated the studies of philosophy and astronomy. The priests of On were esteemed more noble than all the other priests of Egypt. They were always privy counsellors and ministers of state; and therefore, when Pharaoh resolved to make Joseph *prime* minister, he very wisely gave him in marriage a daughter of the priest of *On*, thereby incorporating him into the most venerable cast in Egypt. Bishop Warburton thinks that the superior nobility of the priests of *On* was chiefly owing to their high antiquity and great learning. That they were much given to the study of astronomy, we know from the testimony of Strabo; and indeed nothing is more probable than that they should be attached to the study of that system over which their god, the SUN, presided, not only in his *moral*, but also in his *natural* capacity. The learned prelate affirms, that "whether they received the doctrine from original tradition, or invented it at hazard (which last supposition he thinks more probable, though we are of a very different opinion), it is certain they taught that the Sun is in the centre of its system, and that all the other bodies move round it in perpetual revolutions. This noble theory (he continues) came with the rest of the Egyptian learning into Greece (being brought thither by Pythagoras, who received it from Oenuphis *, a priest of *On*); and after having given the most distinguished lustre to his school, it sunk into obscurity, and suffered a total eclipse throughout a long succession of learned and unlearned ages; till these times restored its ancient splendour, and immoveably fixed it on the unerring principles of science."

* *Plut. de Is. et Osir.* p. 632. Steph. ed.

If it be true, as some philosophers allege, that Moses appears from the first chapter of Genesis to have been acquainted with the true solar system, this account of the origin of that system is extremely probable. As it is of no importance to the civil or religious constitution of a state whether the system of Ptolemy or that of Copernicus be admitted by the people, we cannot reasonably suppose that the Jewish lawgiver was taught astronomy by a revelation from Heaven. But there can be no doubt of his knowing as much of that science as the priests of *On;* for we know that he was instructed in all the wisdom of the Egyptians; and therefore, if he held the sun to be in the centre of the system, it is morally certain that the same thing was held by that priesthood.

ONANIA, or ONANISM, terms employed to denote the crime of self-pollution, mentioned in Scripture to have been committed by Onan, and punished in him with death.

This practice, however common, hath among all nations been reckoned a very great crime. In Scripture, besides the instance of Onan above mentioned, we find self-polluters termed *effeminate*, *unclean*, *filthy*, and *abominable*. Even the heathens, who had not the advantage of revelation, were of the same opinion, as appears from the following lines of Martial.

Hoc nihil esse putes! scelus est, mihi crede; sed ingens
Quantum vix animo concipis ipse tuo.

You think 'tis nothing! 'tis a crime, believe!
A crime so great you scarcely can conceive.

Dr Tissot has published a treatise on the pernicious effects of this shameful practice, which appears to be no less baneful to the mind than to the body. He begins with observing, that, by the continual waste of the human body, aliments are required for our support. These aliments, however, require certain preparations in the body itself; and when by any means we become so altered that these preparations cannot be effected, the best aliments then prove insufficient for the support of the body. Of all the causes by which this morbid alteration is brought on, none is more common than too copious evacuations; and of all evacuations, that of the semen is the most pernicious when carried to excess. It is also to be observed, that though excess in natural venery is productive of very dangerous disorders, yet an equal evacuation by self-pollution, which is an unnatural way, is productive of others still more to be dreaded. The consequences enumerated by Dr Tissot are as follow:

1. All the intellectual faculties are weakened; the memory fails; the ideas are confused, and the patient sometimes

sometimes even falls into a slight degree of insanity. They are continually under a kind of inward restlessness, and feel a constant anguish. They are subject to giddiness; all the senses, especially those of seeing and hearing, grow weaker and weaker, and they are subject to frightful dreams.

2. The strength entirely fails, and the growth in young persons is considerably checked. Some are afflicted with almost continual watching, and others dose almost perpetually. Almost all of them become hypochondriac or hysteric, and are afflicted with all the evils which attend these disorders. Some have been known to spit calcareous matters; and others are afflicted with coughs, slow fevers, and consumptions.

3. The patients are affected with the most acute pains in different parts of the body, as the head, breast, stomach, and intestines; while some complain of an obtuse sensation of pain all over the body on the slightest impression.

4. There are not only to be seen pimples on the face, which are one of the most common symptoms; but even blotches, or suppurative pustules, appear on the face, nose, breast, and thighs; and sometimes fleshy excrescences arise on the forehead.

5. The organs of generation are also affected; and the semen is evacuated on the slightest irritation, even that of going to stool. Numbers are afflicted with an habitual gonorrhœa, which entirely destroys the vigour of the constitution, and the matter of it resembles a fetid sanies. Others are affected with painful priapisms, dysuries, stranguries, and heat of urine, with painful tumours in the testicles, penis, bladder, and spermatic cord; and impotence in a greater or less degree is the never-failing consequence of this detestable vice.

6. The functions of the intestines are sometimes totally destroyed; and some patients complain of costiveness, others of diarrhœa, piles, and the running of a fetid matter from the fundament.

With regard to the cure, the first step is to leave off those practices which have occasioned the disease; which our author asserts is no easy matter; as, according to him, the soul itself becomes polluted, and can dwell on no other idea; or if she does, the irritability of the parts of generation themselves quickly recal ideas of the same kind. This irritability is no doubt much more to be dreaded than any pollution the soul can have received; and by removing it, there will be no occasion for exhortations to discontinue the practice. The principal means for diminishing this irritability are, in the first place, to avoid all stimulating, acrid, and spiced meats. A low diet, however, is improper, because it would further reduce the body, already too much emaciated. The food should therefore be nutritive, but plain, and should consist of flesh rather roasted than boiled, rich broths, &c.

ONCA and ONCE. See FELIS, MAMMALIA *Index*.

ONEEHOURA and ONEEHOW, two small islands of that cluster which was discovered by Captain Cook, and by him called the *Sandwich Islands*. (See SANDWICH ISLANDS). *Oneehoura* is very small, and its chief produce is yams. *Oneehow* is considerably larger, being about ten miles over. It is remarkable for the great quantity of excellent yams which it produces, and for a sweet root called *tee* or *tea*, which is generally about the thickness of a man's wrist, though sometimes much larger. This root, which the natives commonly bake previous to their bringing it to market, is of a wet clammy nature, and with proper management makes excellent beer.

ONEGA, a river and lake of the Russian empire, between Muscovite Carelia, the territory of Cargapol, and Swedish Carelia. It is 100 miles in length and 40 in breadth, having a communication with the lake Ladoga, and consequently with Petersburgh. The river has its source in Cargapol, and gives its name to a country full of woods, and falls into the White sea.

ONEGLIA, a sea port town of Italy, in the territory of Genoa, with the title of a principality; but it belongs to the king of Sardinia, as well as the province, which abounds in olive trees, fruit, and wine. It has often been taken and retaken in the wars of Italy, which is no wonder. as it is an open place. The French and Spaniards had possession of it in 1744, but were driven out by the Piedmontese; however, they retook it the following winter. It was last taken by the French in 1794. E. Long. 7. 51. N. Lat. 43. 58.

ONEIROCRITICA, the art of interpreting dreams; or a method of foretelling future events by means of dreams. See DREAM, DIVINATION, &c.—The word is formed from the Greek ονειρος, "dream," and κριτικη, of κρισηεις, "judgment."—Some call it *oneirocratica*; and derive it from ονειρος and κρατεω, "I possess, I command."

It appears from several passages of Scripture, that there was, under the Jewish dispensation, such a thing as foretelling future events by dreams; bat then there was a particular gift or revelation required for that purpose.

Hence it has been inferred, that dreams are really significative, and do forebode something to come; and all that is wanting among us is the *oneirocritica*, or the art of knowing what: yet it is the opinion of many, that dreams are mere chimeras; bearing indeed some relation to what has passed, but none to what is to come. As to the case of Joseph, it was possible for God, who knew all things, to discover to him what was in the womb of fate; and to introduce that, he might take the occasion of a dream.

ONEIROCRITICS, a title given to interpreters of dreams, or those who judge of events from the circumstances of dreams.

There is no great regard to be had to those Greek books called *oneirocritics*; nor do we know why the patriarch of Constantinople, and others, should amuse themselves with writing on so pitiful a subject.

Rigault has given us a collection of the Greek and Latin works of this kind; one attributed to Astrampsichus; another to Nicephorus, patriarch of Constantinople; to which are added the treatises of Artemidorus and Achmet. But the books themselves are little else than reveries; a kind of waking dreams, to explain and account for sleeping ones.

The secret of oneirocriticism, according to them all consists in the relation supposed to be between the dream and the thing signified: but they are far from keeping to the relations of agreement and similitude; and frequently have recourse to others of dissimilitude and contrariety. Concerning oneirocritics and oneirocritica,

rocritica, the unlearned reader will find much information in Warburton's Divine Legation of Moses, and the books to which he refers.

ONESIÆ THERMÆ, were, according to Strabo *excellent baths*, and *salutary waters*, at the foot of the Pyrenees in Aquitania. Near the river Aturus stands at this day the town Bagneres, famous for its waters, which appear to be the *Onesiæ* of Strabo: situated in the county of Bigorre in Gascony, near the river Adour.

ONIÆ OPPIDUM and *Templum*, (Josephus); so called from Onias, the high-priest of the Jews in Egypt; who built a temple in imitation of that at Jerusalem, by permission of the king of Egypt, on the spot where stood the temple of Diana Agrestis in Leontopolis: it was encompassed with a brick wall, and had a large tower like that at Jerusalem (Josephus); it was the metropolis of the Nomos Heliopolites, (Ptolemy); because in Strabo's time Heliopolis was fallen to decay.

ONGLEE, in *Heraldry*, an appellation given to the talons or claws of beasts or birds, when borne of a different colour from that of the body of the animal.

ONION. See ALLIUM, BOTANY *Index*; and for the mode of its cultivation, see GARDENING *Index*.

ONISCUS, a genus of insects belonging to the order of aptera. See ENTOMOLOGY *Index*.

ONKELOS, surnamed the *Proselyte*, a famous rabbi of the first century, and the author of the Chaldee Targum on the Pentateuch. He flourished in the time of Jesus Christ, according to the Jewish writers; who all agree that he was, at least in some part of his life, contemporary with Jonathan Ben Uzziel, author of the second Targum upon the prophets. Dean Prideaux thinks he was the elder of the two, for several reasons: the chief of which is the purity of the style in his Targum, therein coming nearest to that part of Daniel and Ezra which is in the Chaldee, and is the truest standard of that language, and consequently is the most ancient; since that language, as well as others, was in a constant flux, and continued deviating in every age from the original: nor does there seem to be any reason why Jonathan Ben Uzziel, when he undertook his Targum, should pass over the law, and begin with the prophets, but that he found Onkelos had done this work before him, and with a success which he could not exceed.

Azarias, the author of a book entitled *Meor Enaim*, or the *light of the eyes*, tells us, that Onkelos was a proselyte in the time of Hillel and Samnai, and lived to see Jonathan Ben Uzziel one of the prime scholars of Hillel. These three doctors flourished 12 years before Christ, according to the chronology of Gauz; who adds, that Onkelos was contemporary with Gamaliel the elder, St Paul's master, who was the grandson of Hillel, who lived 28 years after Christ, and did not die till 18 years before the destruction of Jerusalem. However, the same Gauz, by his calculation, places Onkelos 100 years after Christ; and to adjust his opinion with that of Azarias, extends the life of Onkelos to a great length. The Talmudists tell us that he assisted at the funeral of Gamaliel, and was at a prodigious expence to make it most magnificent. Dean Prideaux observes, that the Targum of Onkelos is rather a version than a paraphrase; since it renders the Hebrew text word for word, and for the most part accurately and exactly, and is by much the best of all this sort: and therefore it has always been held in esteem among the Jews much above all the other Targums: and being set to the same musical notes with the Hebrew text, is thereby made capable of being read in the same tone with it in their public assemblies.—From the excellency and accuracy of Onkelos' Targum, the dean also concludes him to have been a native Jew, since without being bred up from his birth in the Jewish religion and learning, and long exercised in all the rites and doctrines thereof, and being also thoroughly skilled in both the Hebrew and Chaldee languages, as far as a native Jew could be, he can scarce be thought thoroughly adequate to that work which he performed; and that the representing him as a proselyte seems to have proceeded from the error of taking him to have been the same with Akilas, or Aquila, of Pontus, author of the Greek Targum or version of the prophets and Hagiographia, who was indeed a Jewish proselyte.

ONOCLEA, a genus of plants belonging to the cryptogamia class and order of *Filices*. See BOTANY *Index*.

ONOMANCIA, or rather ONOMANTIA, a branch of divination, which foretels the good or bad fortune of a man, from the letters in his name. See the article DIVINATION and NAME.

From much the same principle the young Romans toasted their mistresses as often as there were letters in their names: Hence Martial says,

Nævia sex cyathis, septem Justina bibatur.

ONOMATOPOEIA, in grammar and rhetoric, a figure where words are formed to resemble the sound made by the things signified; as the buzz of bees, the cackling of hens, &c. Resemblances of this kind are often fancied when they are not real, though, no doubt, there are in every language some words of which the sound is very like to that which those words are employed to express. Yet, to the mortification of grammarians and rhetoricians, conjunctions, which have been justly pronounced no parts of speech, are the only sounds uttered by men that are wholly natural, and these are fewer than is commonly supposed. See GRAMMAR and LANGUAGE.

ONONIS, a genus of plants, belonging to the diadelphia class. See BOTANY *Index*.

ONOPORDUM, a genus of plants, belonging to the syngenesia class; and in the natural method ranking under the 49th order, *Compositæ*. See BOTANY *Index*.

ONOSANDER, a Greek author and Platonic philosopher, who wrote Commentaries on Plato's Politics, which are lost: but his name is particularly famous for a treatise entitled Λογος Στρατηγικος, "Of the duty and virtues of the general of an army;" which has been translated into Latin, Italian, Spanish, and French. The time when he lived is not precisely known: but is imagined to be in the reign of the emperor Claudius.

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

ONTARIO, a lake of North America, in the country of the Iroquois, 180 miles in length and 60 in breadth. There are many rivers that run into it: and from

from it the great river St Lawrence proceeds. It communicates with the lake Erie by a river 33 miles in length, on which is the remarkable cataract of NIAGARA.

ONTOLOGY. See METAPHYSICS, N° 3.

ONYCOMANCY, or, as some write it, ONYMANCY; a kind of divination by means of the nails of the fingers.——The word is formed from the Greek ονυξ "nail," and μαντεια, "divination."

The ancient practice was to rub the nails of a youth with oil and soot, or wax; and to hold up the nails thus smeared against the sun.—Upon them were supposed to appear figures or characters, which showed the thing required.

ONYX, a mineral substance ranked among gems, which derives its name from the colour resembling that of the nail of the finger. See CARNELIAN, under MINERALOGY, p. 167.

OONALASHKA, one of the islands of the Northern Archipelago, visited by Captain Cook in his last voyage. The native inhabitants of this island are, to all appearances, a very peaceable people, having been much polished by the Russians, who now keep them in a state of subjection. As the island furnishes them with subsistence, so it does, in some measure, with clothing, which is chiefly composed of skins. The upper garment, which is made like a waggoner's frock, reaches down to the knees. Besides this, they wear a waistcoat or two, a pair of breeches, a fur cap, and a pair of boots, the legs of which are formed of some kind of strong gut; but the soles and upper-leathers are of Russia leather. Fish and other sea animals, birds, roots, berries, and even sea weed, compose their food. They dry quantities of fish during the summer, which they lay up in small huts for their use in winter. They did not appear to be very desirous of iron, not to want any other instrument, except sewing needles, their own being formed of bone. With these they sew their canoes, and make their clothes, and also work their curious embroidery. They use, instead of thread, the fibres of plants, which they split to the thickness required. All sewing is performed by the females, who are shoemakers, tailors, and boat-builders. They manufacture mats and baskets of grass, which are both strong and beautiful. There is indeed a neatness and perfection in most of their works, that shows they are deficient neither in ingenuity nor perseverance.

Though the climate is sometimes severe, Captain Cook did not observe a fire-place in any of their habitations. They are lighted as well as heated by lamps; which, though simple, effectually answer the purpose for which they are intended. They consist of a flat stone, hollowed on one side like a plate; in the hollow part they put the oil, mixed with some dry grass, which serves for a wick. Both sexes often warm themselves over one of these lamps, by placing it between their legs, under their garments, and sitting thus over it for several minutes. E. Long. 139. 29. N. Lat. 53. 5.

OONELLA, and OONEMAH, two islands of the same archipelago with Oonalashka; the former of which lies to the north-east of that island, being separated from it by a navigable strait; the other is more to the westward, being in E. Long. 192. 30. and N. Lat. 54. 30. The circumference of Oonella is about seven leagues, and the produce of both much the same with that of Oonalashka.

OPACITY, in *Philosophy*, a quality of bodies which renders them impervious to the rays of light.

OPAH, commonly called the *king fish*. See ZEUS, ICHTHYOLOGY *Index*.

OPAL, in *Natural History*, a species of gems. See MINERALOGY, p. 169.

OPALIA, in *Antiquity*, feasts celebrated at Rome in honour of the goddess Ops. Varro says they were held on the 19th of December, which was one of the days of the Saturnalia: these two feasts were celebrated in the same month, because Saturn and Ops were husband and wife: the vows offered to the goddess were made sitting on the ground,

OPARO, or OPARRO, a small island in S. Lat. 27° 36′, and in E. Long. 215° 49′, which was discovered by Vancouver. This island was supposed to be about 6½ miles long, and it was out of sight of any other land. It is composed of craggy mountains, forming in several places perpendicular cliffs from their summits to the sea, having narrow valleys or chasms interposed. On some of the highest hills were observed some kind of works, resembling fortified places; but as the discoverers did not land on the island, they could not learn their nature and use. In their language and appearance the natives resembled those of the Friendly islands; they seemed acquainted with the use of iron, preferring it to beads and other trinkets, and showed a hospitable disposition. There appeared to be anchoring ground near the north-west end of the island.

OPERA, a dramatic composition set to music, and sung on the stage, accompanied with musical instruments, and enriched with magnificent dresses, machines and other decorations.—This species of drama is of modern invention. In its present state it was not known even in Italy before the beginning of the last century; and at its introduction into England, a century afterwards, it divided the wits, literati, and musicians of the age. By those who were esteemed the best judges of the art, the English language was considered as too rough and inharmonious for the music of the opera; and, on the other hand, critics, whose taste was built on the basis of common sense, looked upon a drama in a foreign and unknown tongue as the greatest of all absurdities. Many of them, however, pleaded for operas in the English language; and it is well known that Addison, who was one of the opposers of the Italian opera on the London stage, wrote in his native tongue the opera of Rosamond. This is confessedly a beautiful poem; but, in the opinion of Dr Burney, it adds nothing to Addison's fame, as it shows his total ignorance of the first principles of music, and of course his unfitness for the task he had undertaken.

In questions respecting the fine arts there is no appeal from the general taste; and therefore, as the French opera, which is in the language of the country where it is acted, has always been admired by persons of liberal education, it doubtless has merit considered as a drama; but how the dramas of this kind which are composed in Italian should find admirers in England among persons who understand not a word of the language, it is to us a matter of astonishment. The music of them may deserve and command the admiration of every one who

Opera. has an ear; and the action of the fingers may be perfectly suitable to the subject represented; but of this suitableness the majority of the audience can be no judges.

Even when the language is thoroughly understood, we should imagine, that, to make an opera agreeable to good sense, much would depend upon the choice of the subject; for it is surely absurd to have persons of all ranks, and on every occasion, perpetually accompanied with the regular responses of symphony. To hear Cæsar, Scipio, or Macbeth, when forming plans to ensure victory, or hatching plots of treason and murder, talking in recitative and keeping time with fiddles, would surely disgust every person whose sense had not all evaporated in sound; but when the subject represented naturally admits of music in real life, we can suppose an opera to afford to persons of taste one of the most exquisite and refined entertainments of which human nature is capable. For a farther account of the opera, see MUSIC, page 497, and POETRY, N° 133, &c.

Operation || Ophioglossum.

OPERATION, in general, the act of exerting or exercising some power or faculty, upon which an effect follows.

OPERATION, in *Surgery* and *Medicine*, denotes a methodical action of the hand on the human body, in order to re-establish health.

OPHIDIUM, a genus of fishes belonging to the order of apodes. See ICHTHYOLOGY *Index*.

OPHIOGLOSSUM, ADDER'S TONGUE, a genus of plants, belonging to the cryptogamia class, and to the order *Filices*. See BOTANY *Index*.

OPHIOLOGY.

INTRODUCTION.

1 Definition. THE term *ophiology* is composed of two Greek words, namely οφις, a *serpent*, and λογος, *discourse*, and consequently denotes that branch of zoology which treats of serpents. The latter constitute an order in the class of amphibious animals. They are covered with scales, breathe by means of lungs, and are destitute of feet and fins.

2 Historical notices of ophiological writers. The hideous aspect of some of the species, and the poisonous properties of others, long contributed to prevent any deliberate investigation of their structure, constitution, and modes of existence. Hence, the ancients, who at
3 Ancient. best had very imperfect notions of classification, sometimes indicate different species under the same name, or bestow different appellations on the same species, and moreover blend their vague descriptions with the embellishments or absurdities of fable.

4 Modern. Among the moderns, few naturalists have directed their researches to the history of serpents. "It must be acknowledged," observes Dr Russel, "that it offers no attractive allurements; and that those who from other avocations, can only spare transient attention to subjects of natural history, are more likely to prefer objects less disgusting, and experiments accompanied with less cruelty and personal danger. Even the eager and resolute naturalist has to contend with many difficulties in this path of research. He cannot, at once, divest himself of the abhorrence, next to innate, of these reptiles; nor can he soon acquire a dexterity in handling them, with that calmness requisite for his own safety. The search for plants, for birds, or even insects, is comparatively pastime, or pleasurable occupation; but in the actual pursuit of the disgusting race of serpents, he stands in need of assistants, who are not at all times to be procured; and if he rely solely on the diligence of such as he may employ, he will find himself exposed to the chagrin of incessant disappointment."

5 Seba. Seba has indeed presented us with a numerous catalogue; but his species are too multiplied, and his descrip-
6 Catesby. tions too concise. Catesby was more solicitous to design and colour his serpents, than to unfold their discrimina-
7 Gronovius. ting characters. The descriptions of Gronovius are, for the most part well and accurately detailed; but they are unprovided with the specific names.

Linnæus, availing himself of the works to which we have just alluded, of the discoveries of Garden, and of his own discernment, published his method of distinguishing the species by the number of scaly plates on the abdomen, and beneath the tail. Experience has indeed proved, that these do not always constitute an infallible criterion, and that more obvious marks, such as the relative size of the head, the length of the body and tail, &c. must sometimes be resorted to: it must, however, be allowed, that the celebrated Swedish naturalist paved the way to a far more accurate nomenclature of serpents than had yet appeared, and that the value of his scientific distinctions is greatly enhanced by the interesting notices on the same subject which are inserted in his *Amœnitates Academicæ*, and in the first and second volumes of his *Adolphian Museum*. 8 Linnæus.

The count de la Cépède has in some respects improved the Linnæan arrangement, and exhibited a more complete catalogue than any of his predecessors. Dr Shaw has likewise displayed his usual sagacity in the second part of the third volume of his General Zoology, which is allotted to his exposition of the serpent tribes. To these we may add, Owen on the natural history of serpents, Klein's Tentamen Herpetologiæ, Blumenbach's Beyträg zur Naturgeschichte der Schlangen, Schneider's Allgemeine Betrochtungen uber die Eintheilung und Kennzeichen der Schlangen, Merian's Beytrage zur geschichte der Amphibien, Laurenti's Specimen Medicum, continens Synopsin Reptilium, Bonaterre's Ophiologie, in the Encyclopédie Méthodique, Latreille's Histoire Naturelle des Reptiles, Russell's Account of Indian Serpents, &c. &c. 9 La Cépède. 10 Shaw. 11 Owen, Klein, &c.

Anatomy and Physiology of Serpents.

THE body of serpents is very long when compared with its thickness; and is sometimes quite cylindrical, or rounded, sometimes compressed on the sides, sometimes flat on the under surface, and sometimes attenuated towards the tail. It is usually covered with scales; but sometimes naked, either rough, or slippery to the touch, and 12 Body.

and banded, ſpotted, or reticulated; the ſkin exhibiting great varieties in the tints and diſtribution of the colours.

13 Head. The head is either diſtinct from the trunk, or confounded with it, and is convex, or flattened, oval, triangular, or heart-ſhaped, and furniſhed with plates, or imbricated ſcales. It includes the mouth, ſnout, jaws, lips, teeth, tongue, eyes, and noſtrils. There is no viſible external ear; though animals of this order doubtleſs poſſeſs the faculty of hearing.

14 Mouth. The mouth is that cavity which is ſituated between the jaws. It is very large in proportion to the ſize of
15 Snout. the head, and is capable of being widely extended. The ſnout is the anterior part of the head: it is ſlanting,
16 Jaws. elongated, obtuſe, truncated, or reflexed. The jaws, which are either of equal or unequal length, are compoſed of two bones, which do not, as ours, open in the manner of a pair of hinges, but are held together at the roots, by a ſtretching muſcular ſkin, ſo as to open as widely as the animal chuſes to ſtretch them. By this contrivance ſerpents are enabled to ſwallow animals
17 Lips. thicker than themſelves. The lips are entire, notched,
18 Teeth. or reflexed. The teeth, in the jaws, are generally ſharp-pointed, and, in ſerpents not poiſonous, are diſpoſed in three rows in the upper jaw, one row exterior and two interior. The under jaw is ſometimes provided with a
19 Fangs. ſingle row. The noxious ſpecies are furniſhed with canine teeth, or fangs, of a tubular ſtructure, ſituated in the projecting part of the upper jaw, commonly of a much larger ſize than the other teeth, and frequently accompanied by ſmaller or ſubſidiary fangs, apparently deſtined to ſupply the principal ones, when loſt either by age or accident. The fangs are ſituated in a peculiar bone, ſo articulated with the reſt of the jaw, as to elevate or depreſs them at the pleaſure of the animal. In a quieſcent ſtate they are recumbent, with their points directed inwards or backwards; but, in the moment of irritation, their poſition is altered by the mechaniſm of
20 Tongue. the above-mentioned bone, in which they are rooted, and they become almoſt perpendicular. The tongue is uſually ſtraight and ſlender, compoſed of two long and rounded fleſhy ſubſtances, which terminate in ſharp points, and are very pliable. They unite at about two thirds length, and the root is connected to the neck by two tendons, which give the whole organ a great variety and facility of motion. In moſt ſpecies, the tongue is almoſt wholly incloſed in a ſheath, or integument, from which the animal can dart it out of its mouth, without opening its jaws; the upper mandible having a ſmall notch, through which it can paſs. Some of the viper kinds have tongues a fifth part of the length of their bodies, and, as they are conſtantly darting them out,
21 Eyes. terrify thoſe who are ignorant of the real ſituation of the poiſon. The eyes are ſmall, when compared with the length of the body, and greatly vary in reſpect of livelineſs and colour. In ſome ſpecies the upper eyelid is wanting, while others have a nictitating membrane, or ſkin, which keeps the organ clean, and preſerves the ſight. In all, the ſubſtance of the eye is hard and horny, the cryſtalline humour occupying a great part of the globe. The pupil is ſuſceptible of conſiderable con-
22 Noſtrils. traction and dilatation, and the iris is often of a golden or fine red colour. The noſtrils are two openings at the extremity of the ſnout, for receiving the ſenſation of ſmell.

23 Trunk. The trunk is that part of the body which reaches from the nape to the vent. It is ſcaly, annulated, tuberculated, or wrinkled; and comprehends the back,
24 Back. ſides, belly, anus, organs of generation, and ſcales. The back is the upper part of the trunk, commencing at the nape and terminating immediately above the vent. In
25 Sides. moſt ſpecies it is rounded, but in ſome carinated or furrowed. The ſides are the lateral portions of the trunk,
26 Belly. from the extremity of the jaws to the vent. The belly, or abdomen, is the lower part of the body, from the
27 Anus. head to the tail, the want of a diaphragm precluding a breaſt. The anus is an opening, uſually tranſverſe, placed at the extremity of the lower ſurface of the trunk, forming the line of demarcation between the latter and the tail, and affording a paſſage to the liquid and ſolid excrements. The penis of the male, and the ovary of the female, are alſo ſituated in this common
28 Scales. vent, from which they are extended only during the ſeaſon of pairing. The ſcales, properly ſo called, are round, oval, oblong, and attenuated at the extremities, rhomboidal, ſmooth, or carinated. The broad undivided plates on the belly and head, are termed *ſcuta*, and the ſmaller or divided plates beneath the tail, are called *ſquamæ ſubcaudales* or *ſcutella*, *ſubcaudal ſcales* or *platelets*.

29 Tail. The tail is attenuated, obtuſe, ſquare, in the form of a triangular pyramid, flattened or compreſſed at the ſides.

30 Skeleton. As ſerpents have neither limbs nor breaſt, the ſtructure of their ſkeleton is much leſs complex than that of quadrupeds. The bones of the head are from eight to ten. The ſkull, which is ſometimes flat and ſometimes convex, is very hard and compact, and exhibits four principal ſutures, which are with difficulty ſeparated. The bones of the trunk conſiſt of a ſeries of vertebræ, incaſed in one another, and articulated with the ribs. The caudal vertebræ are diſpoſed in the ſame manner, and provided with ſimilar proceſſes; but they are unconnected with ribs, and gradually diminiſh in ſize as they approach to the end of the tail. In moſt quadrupeds, the joints in the back-bone ſeldom exceed thirty or forty; whereas in ſerpents they often amount to 145, from the head to the vent, and 25 more from that to the tail. The number of theſe joints muſt give the back-bone a ſurpriſing degree of pliancy, which is ſtill increaſed by the manner in which one is locked into the other. In man and quadrupeds, the flat ſurfaces of the bones are laid one againſt the other, and bound tight by ſinews; but in ſerpents the bones play one within the other, like ball and ſocket, ſo that they have free motion in every direction.

31 Muſcles. The remarkable ſtrength and agility, manifeſted by ſerpents, depend on the vigorous muſcles with which they are provided. Several of theſe are inſerted along and beneath the ſkull, and about the upper and lower jaws. Four, which are denominated *lateral*, have their origin behind the head, and deſcend, by each ſide, to the extremity of the tail. Each vertebra has alſo its correſponding intercoſtal muſcle, which ſerves the ſame purpoſes as in other animals.

32 Viſcera. The internal organs, or viſcera of individuals of this order of animals, nearly correſpond to thoſe of others, and, conſequently, need not long detain us.

33 Brain. The brain is divided into five ſmall portions, which are round, and ſomewhat elongated. The two firſt are

placed

Anatomy of Serpents.

placed between the eyes, and give origin to the olfactory nerves; other two are ſituated in the middle region of the ſkull; and the laſt, which is a little farther back, appears to be the commencement of the ſpinal marrow.

34 Tracheal artery. The tracheal artery, compoſed of diſtinct and cartilaginous rings, has its origin at the top of the gullet, and communicates with the lungs, under the heart.

35 Lungs. The lungs are not lobed, but conſiſt of a cellular and membranous ſubſtance, abundantly furniſhed with blood veſſels.

36 Oeſophagus. The œſophagus is formed of a ſingle membrane, extends to the orifice of the ſtomach, is of an equal diameter throughout, and ſuſceptible of an extraordinary degree of dilatation.

37 Stomach. The ſtomach, which is of a larger capacity, is formed of two concentric tunics, which cloſely adhere, and which are internally covered with folds or wrinkles.

38 Heart. The heart has two ventricles, and is ſmall in proportion to the ſize of the body. As the circulation of the blood is independent of the lungs, the animal is enabled to remain for a conſiderable time under water. It cannot, however, make this element its conſtant reſidence; becauſe occaſional ſupplies of freſh air are neceſſary to preſerve in its blood thoſe qualities which are neceſſary to motion and vitality. In ſerpents, therefore, as well as in viviparous quadrupeds, reſpiration is eſſential to life. This function they do not perform by a rapid ſucceſſion of alternate dilatations and contractions of the lungs; but, having this viſcus remarkably large in proportion to their bodies, they are able to fill it with a conſiderable proviſion of air; and, as they expire very ſlowly, ſome time will elapſe before they are obliged to inſpire again.

39 Inteſtinal canal. The inteſtinal canal is narrow, ſinuous, and internally divided by many tranſverſe partitions.

40 Kidneys. The kidneys are particularly large, and compoſed of ſmall continuous glands, blended with excretory veſſels.

41 External ſenſes. That animals of the ſerpent kind poſſeſs the uſe of the five external ſenſes, can ſcarcely admit of diſpute. We have indeed remarked, that moſt of the ſpecies appear to want an external auditory paſſage; but it is certain that they are often directed to birds, by liſtening to their notes; and many indicate a degree of ſenſibility to the ſounds of muſical inſtruments. Their ſenſe of ſmell, with a few remarkable exceptions, is neither very active nor acute; but, in moſt, that of ſight is quick and penetrating. The ſoft and nervous texture of the tongue and palate would induce a ſuſpicion, that they enjoy the ſenſe of taſte in a pre-eminent degree; yet, as they generally ſwallow their food in large portions, they ſeldom avail themſelves of the delicacy of theſe organs. Being unprovided with feet, hands, or feelers, their ſenſe of touch is probably very imperfect; and even when they twine very cloſely round an object, the interpoſition of their ſcales will render their feeling of its ſurface vague and obtuſe.

42 Sexual union. The ſexual union of ſerpents uſually takes place in the ſunny days of ſpring, is very cloſe and ardent, and varies in duration from an hour to ſeveral days, according to the ſpecies, but terminates without any permanent attachment.

43 Oviparous. The females of ſome are oviparous, and of others viviparous. The eggs of the former vary in reſpect of ſize, colour, and number, according to the ſpecies and conſtitution of the individual; and they are depoſited, not in continuous ſucceſſion, but at intervals, and ſometimes with the appearance of much ſuffering on the part of the female. Segerus relates, that he ſaw a female ſnake, after twiſting herſelf, and rolling on the ground in an unuſual manner, bring forth an egg. He immediately took her up, and facilitated the extruſion of thirteen more, the laying of all which conſumed an hour and a half; for, after depoſiting each, ſhe reſted for ſome time. When he remitted his aſſiſtance, the proceſs was more ſlow and difficult; and the poor animal ſeemed to receive his good offices with gratitude, which ſhe expreſſed by gently rubbing her head againſt his hands. The mother never hatches theſe eggs, but leaves them expoſed in ſome warm ſituation, as in holes with a ſouthern aſpect, on dry ſand, under moſs or foliage, on a dunghill, near an oven, &c. The outer covering of the egg is a thin but compact membrane, and the young ſerpent is ſpirally rolled in its albuminous liquid.

Phyſiology of Serpents.

The viviparous ſpecies differ conſiderably, both with reſpect to their periods of geſtation, and the number of their offspring. 44 Viviparous.

Thus, vipers which go about three months with young, generally breed twice a year, and produce from twenty to twenty-four, while the blind-worm, which is pregnant about a month, brings forth ſometimes ſeven, and ſometimes ten at a birth. When young ſerpents are hatched or produced, they are abandoned to the reſources of their own inſtinct, and often periſh before they have acquired ſufficient experience to ſhun the ſnares which are laid for them by quadrupeds, birds, and reptiles.

In regard to the different ſtages of growth of the different ſpecies, little preciſe information ſeems to have been obtained: and, though ſome arrive at a very large ſize, their dimenſions have, no doubt, been much exaggerated. 45 Growth.

The young of the viper, at the moment of parturition, meaſures from twelve to fifteen lines; and two or three years elapſe before they are capable of reproducing their kind. 46 Size.

Adanſon however concludes, from ocular obſervation, that the largeſt ſerpent in Senegal may meaſure from forty to fifty feet in length, and from a foot to a foot and a half in breadth. Leguat aſſures us, that he ſaw one in Java, that was fifty feet long. Carli aſſerts, that they grow to upwards of forty feet. Mr Wentworth, a gentleman who had large concerns in the Berbices, informs us, that he one day ſent out a ſoldier, with an Indian, to kill wild fowl for the table; and they accordingly went ſome miles from the fort. In purſuing their game, the Indian, who generally marched before, beginning to tire, went to reſt himſelf on the fallen trunk of a tree, as he ſuppoſed it to be; but, when he was juſt going to ſit down, the huge monſter began to move, and the poor ſavage, perceiving that he had approached a Boa, dropped down in an agony. The ſoldier, perceiving what had happened, levelled at the ſerpent's head, and by a lucky aim ſhot it dead. He continued his fire, however, until he was aſſured that the animal was killed; and then going up to reſcue his companion, he found him killed by the fright. The animal was brought to the fort, and was found to meaſure thirty-ſix feet. Mr W. cauſed the ſkin to be ſtuffed, and ſent it as a preſent to the Prince of Orange. We are told, that when Regulus led his army along the banks of the Bagrada, in Africa, an enormous ſerpent diſputed his paſſage acroſs the river. If we can give credit to Pliny, this reptile was 120 feet long, and had deſtroyed many of the ſoldiers, when it was overcome in turn by the battering engines. Its ſpoils were carried to

Physiology of Serpents. to Rome, and the general was decreed an ovation for his success. The skin was preserved for years after in the capitol, where Pliny says that he saw it.

47 Voice. In regard to voice, some serpents are apparently silent, and others have a peculiar cry; but hissing is the sound which they most commonly utter, either as a call to their kind, or a threat to their enemies. In countries where they abound, they are generally silent in the middle of the day; but, in the cool of the evening, they issue from their retreats with continued hissings.

48 Masses of food. The masses of food which serpents are enabled to swallow, would appear quite miraculous, did we not reflect on the lax structure of their jaws, their power of crushing their victims, and the viscid humour, or saliva, which lubricates the crude morsel in its passage down an extensile œsophagus. In spite of all these circumstances, the quantity of aliment is sometimes so voluminous, that it sticks in the gullet, when only partly immersed in the stomach, and the animal lies stretched and nearly motionless, in its retreat, till the swallowed portion be digested, and the extruded half introduced, to undergo the

49 Capability of abstinence. same process. But, though serpents thus occasionally gorge themselves with food, as their blood is colder than that of most other terrestrial animals, and circulates slowly, their powers of digestion are feeble and tardy, so that they can endure weeks, and even months of abstinence. Nay, so tenacious are they of the vital principle, that they exist and grow in mephitic marshes, continue to breathe, for a considerable time, in the exhausted receiver of an air-pump, and frequently exhibit symptoms of life after one part of the body has been severed from the other. Vipers are often kept in boxes, for six or eight months, without any food whatever; and there are little serpents sometimes sent to Europe from Cairo, which live for several years in glasses, and never eat at all.

50 Age. The natural term of the existence of serpents, is not accurately known; but it has been conjectured, that some of the larger kinds may complete a century. The first failure of their strength is the almost immediate forerunner of their dissolution; for, when deprived of the requisite elasticity of frame to spring on their prey, and of the requisite force to combat their enemies, they shrink into their recesses, and die of hunger, or are easily devoured by the ichneumon, stork, and other powerful assailants.

51 Hybernation. In the more northerly and temperate regions of the globe, the serpent tribes, towards the end of autumn, fall into a state of torpor, more or less profound, according to the greater or less intensity of the cold; and in this condition they remain, nearly lifeless, till the approach of spring reanimates their stiffened frame.

52 Renewal of skin. Soon after its resuscitation, the serpent works itself out of its old epidermis, by rubbing itself against the ground, or by wedging itself between any two substances that are sufficiently close to each other. The exuviæ come off entire, being loosened first about the head; and are always found turned inside out. It is some time before the scales acquire a sufficient degree of hardness to defend the animal against external injury; and, during this interval, it generally confines itself to its retreat.

Crotalus.

Generic and Specific Exposition of the Order.

Gen. 1. Crotalus. *Rattle-Snake.* 53 Crotalus.

54 Generic characters. Scuta on the abdomen, scuta and squamæ beneath the tail, rattle terminating the tail.

The animals of this genus inhabit America, where they prey on the smaller birds, lizards, and insects. They are furnished with poisonous fangs, and have a broad head, covered with large scales. Their snout is obtusely rounded.

55 Horridus. *Banded Rattle-Snake, Common Rattle-Snake*, or *Boiquira.*—The characters are, 167 abdominal, and 23 subcaudal scuta. The ordinary length of this species is from three to four or five feet, and the greatest thickness that of a man's arm. The prevailing colour is a yellowish brown, marked with cross and irregular bands of a deeper shade, and two or three longitudinal stripes from the head down the neck; the under parts are of a dingy brown, with many dusky variegations and freckles. The mouth is capable of great distension. The tongue is black, slender, bipartite, and inclosed in a kind of sheath, from which the snake darts forth the double point, and vibrates it with great velocity. The rattle-snake is viviparous, producing in June about twelve young, which, by September, acquire the length of about twelve inches. These, it is said to preserve from danger, like the viper in Europe, by receiving them into its mouth, and swallowing them. In confirmation of this assertion, we shall quote the words of M. de Beauvois, who, during his residence in America, bestowed particular attention on the history of amphibious reptiles.

"Among the information which I endeavoured to obtain in my travels with respect to serpents in general, there was one point which greatly excited my curiosity. Several persons, and one among the rest to whom I owe a debt of gratitude for civilities and marks of friendship, which will for ever rest engraven on my heart, had informed me, that the female rattlesnake concealed its young ones in its body; that when they were alarmed by any noise, or by the approach of man, they took refuge in the body of their mother, into which they entered by her mouth. This fact had been already ascertained with respect to the viper of Europe; but in consequence of the unfavourable and repulsive dispositions inspired by this kind of reptile, and in order to render it still more hideous, an absurd interpretation was given to this fact. It was pretended, that this serpent eats its little ones after having given them birth. Curious to verify this fact related of the boiquira, I was constantly occupied with this idea, and began to despair of ever making the observation, when, at a moment in which I thought the least of it, accident furnished me the means. Having fallen sick among the Indians, I found myself obliged to remain a few days with one of them in the neighbourhood of Pine-log. During my convalescence, I took a walk every morning in the neighbourhood, and one day when I was following a pretty broad path, I perceived, at a distance, a serpent lying across the road in the sun. I had a stick in my hand, and drew near to kill it; but what was my surprise, when, in the moment that I was about to give the blow

the

Crotalus. the reptile perceived me, coiled up itſelf, and opened its large mouth, into which five ſerpents, which I had not till then obſerved, becauſe they were lying along its body, ruſhed into the gulf which I had conceived opened for myſelf. I retired to one ſide, and hid myſelf behind a tree. The reptile had crawled a few paces, but hearing no further noiſe, and not perceiving me, ſtretched itſelf out afreſh. In a quarter of an hour the young ones came out again. Satisfied with this obſervation, I advanced anew towards the animal, with intention to kill it and examine the interior of its ſtomach: but it did not permit me to approach ſo near as it did the firſt time, the young ones entered with ſtill greater precipitation into their retreat, and the boiquira fled into the graſs. My ſatisfaction and aſtoniſhment were ſo great, that I did not think of following it."

The rattle conſiſts of a number of pieces, inſerted into each other, all alike in ſhape and ſize, hollow, and of a thin, elaſtic, brittle ſubſtance, ſimilar to the exterior part of the ſcuta. Their form is nearly that of an inverted quadrilateral pyramid, with the corners rounded off. The firſt piece, or that neareſt the body, may be conſidered as a kind of caſe, which contains the three laſt vertebræ of the tail, on which it appears to be moulded, and has three convex, circular elevations correſponding with them; the two laſt of theſe elevations are fitted into the two firſt of the next piece; ſo that of every piece except the laſt, the firſt only of the elevations is expoſed to view, the two others being incloſed in thoſe of the following, in which they have room to play from ſide to ſide. Theſe ſeveral pieces have no muſcles, nerves, nor ligaments, nor are they connected, either with each other, or with the body of the ſerpent any otherwiſe than by the mode of inſertion already deſcribed. Thus they derive no nouriſhment from the animal, and are merely an appendage which can have no other motion than what is communicated to it by that of the tail. Theſe ſeveral pieces of which the rattle conſiſts, appear to have been ſeparately formed. Dr Van Meurs imagines them to be no other than the old epidermis of the tail, which, when its nouriſhment is intercepted by the new ſkin formed beneath it, grows hard and brittle. Hence, he ſuppoſes, that whenever this part acquires a new ſkin, a new piece of the rattle is added to the former, which is thus detached from the vertebræ, and ſhoved farther from the tail. The number of theſe pieces, however, affords no certain criterion of the animal's age, becauſe thoſe which are moſt remote from the tail, become ſo dry and brittle, that they are very liable to be broken off and loſt.

The two principal fangs are placed without the jaws, on a ſeparate bone, and the ſmaller ones attached to muſcles and tendons. Theſe fangs may be couched, or raiſed, at the pleaſure of the animal, and are furniſhed with an opening near the root, and a ſlit rowards the point, ſo that on preſſing gently with the finger on the ſide of the gum, the poiſon, which is yellowiſh, is perceived to iſſue from the hollow of the tooth, through the ſlit. The veſicle which contains the poiſon, is externally of a triangular form, and of a tendinous texture; internally, it is cellular; and its anterior part terminates in a ſmall duct, communicating with the ſacculus which covers the perforated teeth. It is furniſhed with a conſtrictor muſcle, for the purpoſe of expreſſing its contents. The virulence of the latter may be inferred from various experiments reported in the Philoſophical Tranſactions, and other publications. A rattleſnake of about four feet long, being faſtened to a ſtake, bit three dogs, the firſt of which died in leſs than a quarter of a minute; the ſecond, which was bitten a ſhort time afterwards, in about two hours, and the third, which was bitten about half an hour afterwards, ſhowed the viſible effects of the poiſon in three hours, and likewiſe died. Other experiments were inſtituted; and laſtly, in order to try if the ſnake could poiſon itſelf, it was provoked to bite a part of its own body, and actually expired in leſs than twelve minutes. Our limits will not permit us to enumerate various other inſtances of the almoſt inſtantaneous effects of this poiſon, which is moſt to be dreaded in hot weather, and when the animal is much irritated. The rattle-ſnake, however, is rather afraid of man, and will not venture to attack him unleſs provoked. It moves ſlowly, for the moſt part with its head on the ground; but if alarmed, it throws its body into a circle, coiling itſelf, with the head erect in the centre, and with its eyes flaming in a terrific manner. In caſes of ſlight bites, the Indians uſually ſuck the wound. They have likewiſe recourſe to the juices of various herbs, and to the root of *polygala ſencka*; but theſe applications produce little effect, without ſcarification and ligatures. According to Dr Barton, the rude and ſimple practice of the weſtern ſettlers, is, firſt, to throw a tight ligature above the part into which the poiſon has been introduced, at leaſt as often as the circumſtances of the caſe admit of ſuch an application. The wound is next ſcarified, and a mixture of ſalt and gunpowder, or either of theſe articles, ſeparately, laid on the part. Over the whole is put a piece of the bark of *juglans alba*, or white walnut-tree, which acts as a bliſter. At the ſame time, a decoction or infuſion of one or more ſtimulant vegetables, with large quantities of milk, are adminiſtered internally: the doctor is, nevetheleſs, of opinion, that the beneficial effects of this mode of treatment are chiefly to be aſcribed to the external applications. If the fang has penetrated a vein or artery, or attacked the region of the throat, the bite commonly proves fatal, and the patient expires in dreadful agony. "Where a rattle-ſnake, (ſays Cateſby), with full force, penetrates with his deadly fangs, and pricks a vein, or artery, inevitable death enſues; and that, as I have often ſeen, in leſs than two minutes." "The Indians, (he continues), know their deſtiny the minute they are bit; and, when they perceive it mortal, apply no remedy, concluding all efforts in vain." Dr Barton, however, inclines to think, that this aſſertion ſhould be received with conſiderable limitation, and that the application of ligatures, &c. even in caſes apparently the moſt deſperate, ſhould not be neglected. According to Clavigero, the moſt effectual method is thought to be, the holding of the wounded part ſome time in the earth. But if the poiſon be once received into the general maſs of the blood, it is almoſt needleſs to have recourſe to medicines. A conſiderable degree of nauſea is uſually the firſt alarming ſymptom; the pulſe becomes full, ſtrong, and greatly agitated; the whole body ſwells; the eyes are ſuffuſed with blood; a hemorrhage frequently proceeds from the eyes, noſe and ears; large quantities of blood are ſometimes thrown out on the ſurface of the body, in the form of ſweat; the teeth vacillate in their ſockets; and the pains and groans of Crotalus.

Crotalus.

of the unhappy ſufferer too plainly indicate, that the moment of diſſolution is near at hand.

The following remarkable caſe is related by Mr Hector St John. A farmer was one day mowing with his negroes, when he accidentally trod on a rattle-ſnake, which immediately turned on him, and bit his boot. At night, when he went to bed, he was attacked with ſickneſs, his body ſwelled, and before a phyſician could be called in, he died. All his neighbours were ſurpriſed at his ſudden death; but the body was interred without examination. A few days after, one of the ſons put on the father's boots, and, at night, when he pulled them off, he was ſeized with the ſame ſymptoms, and died on the following morning. The phyſician arrived, and, unable to divine the cauſe of ſo ſingular a diſorder, ſeriouſly pronounced both the father and ſon to have been bewitched. At the ſale of the effects, a neighbour purchaſed the boots, and on putting them on, experienced the like dreadful ſymptoms with the father and ſon. A ſkilful phyſician, however, being ſent for, who had heard of the foregoing accidents, ſuſpected the cauſe, and by applying proper remedies, recovered the patient. The fatal boots were now carefully examined, and the two fangs of the ſnake were diſcovered to have been left in the leather, with the poiſon-bladders adhering to them. They had penetrated entirely through, and both the father and ſon had imperceptibly ſcratched themſelves with their point in pulling off the boots.

We are informed by Dr Barton, that a gentleman of Philadelphia had a large rattle-ſnake brought to him alive, which he ſo managed by a ſtring, that he could eaſily lead it into, or out of a cloſe cage. On the firſt day, he ſuffered this ſnake to bite a chicken, which had been allured to the mouth of the cage by crumbs of bread. In a few hours, the bird mortified, and died. On the ſecond day, another chicken was bitten in the ſame manner, and ſurvived the injury much longer than the firſt. On the third day, the experiment was made on a third chicken, which ſwelled much, but, nevertheleſs, recovered. On the fourth day, ſeveral chickens were ſuffered to be bitten, without receiving any injury. Theſe ſimple experiments enable us to aſſign a reaſon, why perſons who have actually been bitten by the rattle-ſnake, have ſometimes experienced very inconſiderable, or no bad conſequences from the wound; they ſhew in what manner many vegetables have acquired a reputation for curing the bites of ſerpents, without our being obliged to impeach the veracity of thoſe from whom our information is derived; and laſtly, they teach us the phyſiological fact, that the poiſon of this reptile is ſecreted very ſlowly.

It has been obſerved by M. Gauthier, that the poiſon ſtains linen with a green hue, which is deeper in proportion as the linen has been impregnated with lixivium.

The pretended faſcinating power of the rattle-ſnake is now generally diſcredited; and Dr Barton, profeſſor of natural hiſtory in the univerſity of Pennſylvania, reduces the whole to the fluttering of old birds in defence of their young, and too near an approach to the formidable enemy. In confirmation of this opinion, he obſerves, that he can trace no alluſion to the alleged faſcinating faculty, in the ancient writers of Greece and Rome; that he doubts if it is credited by the American Indians; that Linnæus was extremely credulous; that the enchanting power of the rattle-ſnake is queſtioned by ſome eminent European naturaliſts; that the breath of this reptile is not remarkably infectious or peſtiferous; that it often fails in catching birds; that the latter, and ſquirrels, are not its principal food; and that it is even devoured by ſome of the larger kinds of birds.

Mr Peale, an intelligent and zealous naturaliſt, kept a rattle-ſnake alive for five years and a half. "Curious to enquire, (ſays M. Beauvois), how this animal ſeizes his prey, he (Mr Peale) has confined ſeveral birds in the ſame cage with him, and the hungry reptile has made many attempts to take hold of the bird. This experiment has been repeated many times, and every time with the ſame effect. I have ſeen, myſelf, one of theſe birds in the cage; but whether the reptile was not hungry, or was ſenſible of its want of power, it remained perfectly tranquil, while the bird was perfectly at eaſe. It gave no indication which could make it be believed that it was either enchanted or affrighted; and the air did not appear different, if we might judge from its behaviour, from that which it found in an ordinary cloſe cage. The bird remained two days in the ſame ſituation, without the leaſt attention paid to it by the reptile, who, in the meantime, eat a dead one which was preſented to him.

"Another living bird was put into the cage with the ſerpent: far from being alarmed, it amuſed itſelf with pecking in the bottom, and picking up a few grains which it found there: often changing place in its accuſtomed manner, and even reſting itſelf on the back of the boiquira, which made no extraordinary movements. This experiment was made ſeveral times.

"Mr Peale, his children, and myſelf, have often examined the reptile. We never perceived it to ſend out the ſlighteſt ſuffocating odour. It is in vain to object, that the living birds thus given it were not of the kind fitted for its nouriſhment; for it has eaten the ſame birds, when preſented to it dead, and it is not uſeleſs to remark, that it never refuſed one of them."

Cateſby mentions an individual of this ſpecies, which was about eight feet long, and weighed from eight to nine pounds. It was ſeen gliding into a gentleman's houſe, and terrified all the domeſtic animals.

Mr St. John, whom we have quoted above, once ſaw a tamed rattle-ſnake, as gentle as it is poſſible to conceive a reptile to be. It went to the water, and ſwam wherever it pleaſed; and when the boys to whom it belonged called it back, their ſummons was readily obeyed. They often ſtroked it with a ſoft bruſh: and this friction ſeemed to cauſe the moſt pleaſing ſenſations; for it would turn on its back to enjoy it, as a cat does before the fire. We need ſcarcely add, that it had been deprived of its fangs.

Rattle-ſnakes abound in America, from Brazil to near Lake Champlain: but they are gradually diſappearing in the more populous diſtricts. According to Pennant, they affect woods and lofty hills, eſpecially where the ſtrata are rocky or chalky, as at the paſs near Niagara. They particularly frequent the ſides of rills, to prey on ſuch ſmall animals as reſort thither to quench their thirſt. In ſummer, they are generally found in pairs; in winter, they collect in multitudes, and retire under ground, beyond the reach of froſt. Tempted by the warmth of a ſpring day, they often creep out, weak and languid. A perſon has ſeen a piece of ground covered with them, and killed with a rod between ſixty

and

Crotalus. and feventy, till, overpowered with the ftench, he was obliged to retire. They are moft eafily difpatched by a blow with a ftick on the fpine.

The American Indians often regale on the rattle-fnake. When they find it afleep, they put a fmall forked ftick over its neck, which they keep immoveably fixed to the ground, giving the fnake a piece of leather to bite; and this they pull back feveral times with great force, until they perceive that the poifon fangs are torn out. They then cut off the head, fkin the body, and cook it, as we do eels. The flefh is faid to be white and excellent. Hogs alfo fometimes devour the rattle-fnake; but horfes, dogs, and moft other animals, regard it with antipathy and horror.

56 *Duriffus.* *Striped Rattle-fnake*, or *White Rattle-fnake.*—172 abdominal, and 21 fubcaudal fcuta. From a foot and a half, to four feet and a half long. Diftinguifhed from the preceding by a pattern of pale yellow ftreaks, forming a feries of large rhombs, or lozenges, down the back. Has often been confounded with the former, on account of the fame general afpect, conftitution, and habits.

57 *Dryinas.* *Wood Rattle-fnake.*—165 abdominal, and 30 fubcaudal fcuta. Of a lighter tinge than the two preceding, and marked with yellowifh variegations on the back.—This fpecies has been hitherto very imperfectly defcribed; and Seba erroneoufly quotes it as a native of Ceylon.

58 *Miliaris.* *Miliary*, or *Small Rattle-fnake.*—132 abdominal, and 32 fubcaudal fcuta. Gray, with a triple row of black fpots, and a red fpot between each of the dorfal ones. The fmalleft of the genus; its ordinary length being about eighteen inches. From this circumftance, and the faint found of its rattle, it is more dangerous than the larger fpecies. It is alfo alleged, that its bite is more active. Its poifon, according to Lebeau, is moft fuccefsfully combated by the volatile alkali. It is confined to the temperate regions of North America, particularly to Carolina, Louifiana, and Florida.

59 *Atricaudatus.* *Black-tailed Rattle-fnake.*—170 abdominal, and 26 fubcaudal fcuta. The head greenifh-gray, with two brown and oblong fpots on the hinder part. The body of a reddifh gray, fpeckled with brown points, and croffed by 24 lengthened patches, or bands, brown, and irregular, and accompanied, on each fide, by two fpots of a brighter colour. The back is marked by a longitudinal, fawn-coloured ftripe. Scales very numerous, rhomboidal, and carinated.—From three to four feet long; a very venomous fpecies; difcovered by Bofc, in Carolina, and defcribed in Daudin's Natural Hiftory of Reptiles.

60 Boa.

Gen. 2. Boa.

61 Characters. Scuta on the abdomen, and under the tail; but no rattle.

The boa tribe of ferpents is very numerous, and contains fome fpecies which are remarkable for their huge dimenfions. Their head is covered, like that of the crotali; but their tail terminates in a point. Their immenfe fize has rendered them the objects of terror rather than of obfervation to mankind; while the quantity of food requifite for their fuftenance, has precluded their multiplication within a limited range of country. Hence, a confiderable degree of confufion attaches to their hiftory; and a rational fufpicion arifes, that, with the progrefs of culture and population, fome of the more formidable forts have either been exterminated, or driven from the haunts of men. Some naturalifts have afferted, that individuals belonging to this genus have been found in Spain, Italy, and the fouth of France; but they appear to have miftaken fome of the larger forts of coluber for the boa, which laft is a native of Afia, Africa, and America. Boa.

Great or *Conftrictor Boa.*—240 abdominal, and 60 fubcaudal fcuta. The more ordinary difpofition of its colouring is yellowifh gray with a large, chefnut-coloured, chain-like pattern down the back, and triangular fpots on the fides. A confiderable degree of variety, however, is occafioned by the circumftances of age, fex, and climate; and even the number of fcuta is by no means conftant. Nature has beftowed on this celebrated reptile, uncommon ftrength and beauty, but has wifely withholden from it the poifonous properties of fome of the fmaller fpecies. It frequently attains to twenty, or even thirty feet in length. Except, however, when ftimulated by the calls of hunger, it is a fluggifh and harmlefs animal, affecting moift and fhady fituations, and, occafionally, devouring large animals, which it crufhes in its contorted folds. In the German Ephemerides, we have an account of a combat between one of thefe huge ferpents and a buffalo, by a perfon who affures us, that he was himfelf a fpectator. The ferpent had for fome time, been waiting near the brink of a pool, in expectation of prey, when a buffalo was the firft animal that appeared. Having darted on the affrighted beaft, it inftantly began to wrap him round in its voluminous twiftings, and, at every twift, the bones of the buffalo were heard to crack almoft as loud as the report of a gun. It was in vain that the quadruped ftruggled and bellowed; its enormous enemy twined it fo clofely, that at length all its bones were crufhed to pieces, like thofe of a malefactor on the wheel, and the whole body reduced to one uniform mafs. The ferpent then untwined its folds, to fwallow its prey at leifure. To prepare for this, and alfo to make it flip down more fmoothly, it licked the whole body over, and fmeared it with a mucilaginous matter. It then began to fwallow it at the end that offered the leaft refiftance, the throat dilating to fuch an extraordinary degree, as to admit a fubftance which was thrice its own thicknefs. 62 *Conftrictor.*

In the Bombay Courier, of Auguft 31, 1799, it is ftated, that as a Malay prow anchored for the night, clofe under the ifland of Celebes, one of the crew went on fhore, in queft of betel nut in the woods, and on his return, lay down to fleep, as it is fuppofed, on the beach. In the courfe of the night, he was heard by his comrades, to fcream out for affiftance. They immediately went on fhore; but an immenfe fnake of this fpecies had already crufhed him to death. The attention of the monfter being entirely occupied with his prey, the people went boldly up to it, cut off its head, and took both it and the body of the man on board their boat. The fnake had feized the poor fellow by the right wrift, where the marks of the teeth were very diftinct; and the mangled corpfe bore evident figns of being crufhed. The length of the fnake was about thirty feet, its thicknefs equal to that of a moderately fized man; and, on extending its jaws, the gape was found

found wide enough to admit a body of the size of a man's head.

The female deposits a considerable number of eggs, which seldom exceed three inches in their greatest diameter, on the sand, or under leaves exposed to the sun's rays.

In some districts of Africa, the great boa is regarded as an object of veneration, and on the coast of Mozambique, is worshipped as a god.

In a very interesting notice of this species, communicated to us by John Corse Scott, Esq. mention is made of a live individual, which was discovered in a field, near the cattle, by some labourers, in the province of Tipperah in Bengal. This snake, which measured fifteen feet and three inches in length, and eighteen inches in circumference, was stunned by repeated blows, before it could be secured, and tied with cords to a long bamboo. It was pretty active after it was untied, and made frequent darts at any person coming near it. On presenting a long stick, it repeatedly seized and bit it with great fierceness. On dissection, the heart was found to be of the size of a sheep's, with the communication open between the two ventricles. The liver was small in proportion, being about the size of the human pancreas, and, like it, divided into several lobes. The œsophagus, from the mouth to the pylorus, measured nine feet three inches, and its width was sufficient to admit a man's head with ease. The head was small, in proportion to the size of the animal, the eyes were dark and heavy, and the nostrils large; but there was no perceptible organ of hearing. From the mechanism of the jaws, they were capable of being distended so as to admit a substance or animal much thicker than the snake itself. This mechanism, and the absence of grinders, obviously prove, that the food is swallowed entire, without mastication. In a gorged individual of this species, Mr S. found an entire guana, and in another, a fawn, of a year old; but the bones of these quadrupeds were unbroken.

63 *Scytale.* *Spotted Boa.*—250 abdominal, and 70 subcaudal scuta. Cinereous, with large, round, black spots on the back, and smaller ones, with white centres, on the sides, and oblong markings, interspersed with smaller variegations on the abdomen. Of a size scarcely inferior to the preceding, and of similar manners. It is a native of several parts of South America, and, like other snakes, occasionally eaten by the Indians.

64 *Cenchris.* *Ringed Boa.*—265 abdominal, and 57 subcaudal scuta. General cast ferruginous, with large dark rings on the back, and blackish kidney-shaped spots, with white centres on the sides. The *aboma* of several writers. Grows to a large size, and is a native of South America, where it is treated with divine honours.

65 *Canina.* *Canine* or *Green Boa.*—203 abdominal, and 77 subcaudal scuta. Green, with cross, waving, and white dorsal bands. It has its specific name from the form of its head, which resembles that of a dog. Though destitute of poison fangs, it inflicts a severe bite, when provoked. It measures from four to twelve feet in length, inhabits South America, and is celebrated for its beauty.

66 *Phrygia.* *Embroidered Boa.*—A remarkably elegant species, native of the East Indies, and omitted by Linnæus. White, with a cinereous tinge on the back, and the body marked with black lace-like variegations.

Garden Boa.—290 abdominal, and 123 subcaudal scuta. Yellowish gray, with brown variegations, resembling in form the parterres of an old-fashioned garden, the body somewhat compressed, and the sides marked with cuneiform spots. From two to three or four feet long, and native of South America. 67 *Hortulana.*

Fasciated Boa.—233 abdominal, and 36 subcaudal scuta. Yellow, with dusky blue transverse bands. The body somewhat triangular, upwards of five feet in length, and five inches in the thickest part. Native of India, and very poisonous. 68 *Fasciata.*

An individual of this species was sent to Dr Russel, in a very languid and extenuated state. Being set at liberty, it remained for some time without moving, but soon began to crawl slowly towards a dark corner. A chicken being presented, it seemed not to regard it, though the bird fluttered about it, and even rested a toe on its head. The chicken was then put on the snake's back, and clung so fast with its toes, that, when attempted to be separated, the snake was dragged a little way, without offering to resent the insult. An hour after, the chicken was again presented; but the snake shewing no disposition to bite, its jaws were forced asunder, and the naked thigh of the chicken so placed, that the jaws closed on part of it. The chicken, when disengaged, shewed immediate symptoms of poison: it couched, purged once or twice, and was not able to stand. In the course of the first ten minutes, after several ineffectual efforts to rise, it rested its beak on the ground; and the head was seized with paralysis. After 15 minutes, it shewed a frequent disposition to lie down; but remained couched some minutes longer. In 20 minutes, it lay down on one side, and, convulsions supervening soon after, it expired within 26 minutes.

Viperine Boa.—209 abdominal, and 19 subcaudal scuta. Gray, with a black waving dorsal band, edged with white; the sides spotted with black. About a foot and a half in length, including the tail, which is only one inch and a half long. Native of India, where its bite is said to produce a slow wasting of the fingers and toes. As, however, it has no fangs, and produces no deleterious effects on brute animals: the truth of the report seems to be very questionable. 69 *Viperina.*

Lineated Boa.—209 abdominal, and 47 subcaudal scuta. Blackish line, with white dotted, transverse, arched lines, and whitish abdomen. Slender, native of India, and highly poisonous. 70 *Lineata.*

Annulated Boa.—About two feet in length, somewhat ferruginous, with black rounded spots, included in rings, on the back, reniform ocellated spots on the sides, and waving dusky variegations on the abdomen. Native of South America, figured by Madame Merian, and preserved in the Hunterian Museum, at Glasgow. 71 *Annulata.*

The other species belonging to this genus are, *enydris*, *ophryas*, *regia*, *murina*, *horatta*, *hipnale*, *contortrix*, and *palpebrosa*.

Gen. 3. Coluber, *Snake* (properly so called). 72 Coluber.

Scuta, or undivided plates, under the abdomen; squamæ, or broad alternate scales, under the tail. The lat- 73 Characters.

Coluber.

ter, although alternate, are reckoned by pairs; but, in many instances, the number is still undetermined, and it sometimes varies in the same species.

This tribe contains about 200 species, which greatly differ from one another in size and habit. The poisonous sorts, which constitute about one-fifth of the whole, are generally distinguished from the rest by their large, flattish, subcordate heads, and rather short bodies and tails; whereas most of the harmless species have small heads, with longer bodies and tails in proportion. Laurenti and Latreille have ranged the former under the genus *Vipera*, and the latter under that of *Coluber*: but Linnæus, Daubenton, La Cépède, &c. include both sorts under *Coluber*. This family of serpents is widely diffused over various quarters of the world.

74 *Berus.* *Common Viper.*—146 abdominal scuta, 39 subcaudal scales. Attains to the length of two, or even of three feet. The ground colour of the body is a dingy yellow, deeper in the female than in the male. The back is marked with rhomboidal, as the sides are with triangular, black spots. Its black belly, the greater thickness of the head, and the more abrupt termination of the tail, sufficiently distinguish it from the common snake, with which it has been often confounded.

The viper arrives at maturity in six or seven years, and produces 10 or 12 live young at the end of the second or third. Mr White of Selborne killed and cut up a pregnant female, and found in the abdomen 15 young ones, about the size of full grown earth-worms. No sooner were they freed from confinement, than they twisted and wriggled about, set themselves up, and gaped very wide when touched with a stick, exhibiting manifest tokens of menace and defiance, though as yet no fangs were visible, even with the help of glasses.—That the young, for some time after birth, retreat, when alarmed, into the mouth of the mother, seems to be a fact satisfactorily ascertained.

Vipers are capable of supporting long abstinence, feed on reptiles, worms, and young birds, and become torpid in winter. Their poison rarely proves fatal to man, and is most successfully counteracted by olive oil, thoroughly rubbed on the wounded part. They are usually caught by wooden tongs, at the end of the tail, as, in that position, they cannot wind themselves up to injure their enemy. Their flesh was formerly in high esteem, as a remedy for various diseases, particularly as a restorative. Of late years, however, it has lost much of its ancient credit, and is rarely prescribed by modern practitioners.

The common viper inhabits Europe and Siberia, and is by no means uncommon in Great Britain, being the only poisonous animal in the island, frequenting dry and stony districts, and especially the chalky countries. It abounds in some of the Hebrides, and is called *adder* by the Scots.

This species is subject to several varieties, which we cannot stop to enumerate. The *prester*, or *black viper*, resembles the *berus*, in almost every particular but colour; though Linnæus, and other eminent naturalists, rank it as a distinct species.

75 *Cacodæmon.* *American Black Viper.*—About the length of the preceding, but much thicker, black, and remarkable for the largeness of its head, which it distends, with a horrid hiss, when irritated. Its bite is reckoned as dangerous as that of the rattlesnake. It is a native of Carolina, chiefly frequenting higher grounds.

Egyptian Viper.—118 abdominal scuta, and 22 subcaudal scales. Somewhat ferruginous, spotted with brown; whitish beneath, with a short mucronated tail. Rather smaller than the common species. Imported in considerable quantities to Venice, for the use of the apothecaries in the composition of theriaca, &c. Native of Egypt, and supposed by some to be the asp of Cleopatra; but it is very difficult to ascertain the true asp of the ancients. 76 *Vipera.*

Charasian Viper.—Rufous, with the snout acuminated above, and the body marked with short, subconfluent, dusky, and transverse streaks. Nearly allied to the common species, and described by Charas, a celebrated anatomist of serpents, in his day, but who contended, in opposition to Redi, that the symptoms caused by the viperine bite, proceeded from what he termed the *enraged spirits* of the creature, and not from the supposed poisonous fluid. 77 *Charasii.*

Redi's Viper.—152 abdominal scuta, and 32 subcaudal scales. Of an iron brown colour, with a quadruple transverse series of short, subconfluent, brown streaks on the back. In other respects nearly allied to the common viper, but said to be more poisonous. It occurs in Austria and Italy, and is the sort which Redi chiefly employed in his experiments relative to animal poison. 78 *Redi.*

Asp.—155 abdominal scuta, and 37 subcaudal scales. Somewhat rufous, with roundish, alternate, dusky spots on the back, and subconfluent ones near the tail. About three feet long, the head rather large, and covered with small carinated scales. Native of France, particularly of the northern provinces of that country. It is very doubtful if this be the genuine *coluber aspis* (Lin.); and still more so if it be the *asp* of the ancients. 79 *Aspis.*

Greek Viper.—155 abdominal scuta, and 46 subcaudal scales. Gray, with a fourfold series of transverse spots, those on the middle yellowish, and those on the sides dusky. Nearly a cubit in length, very thick towards the middle, and the head large and depressed. Inhabits Greece and the Grecian islands. According to Forskäl, its bite proves fatal by inducing insuperable sleep. 80 *Lebetinus.*

Cerastes, or *Horned Viper.*—150 abdominal plates, and 25 subcaudal scales. Pale yellowish, or reddish brown, with a few round, distant, or oblong spots, of a deeper tinge, scattered along the upper parts of the body, and the belly of a pale leaden hue. The two curved processes, situated above the eyes, give the animal a more than ordinary appearance of malignity. Its length varies from about 15 inches to two feet. It is found in many parts of Africa, especially affecting dry places, and sandy deserts, and inflicting a dangerous wound on those who happen to approach it. 81 *Cerastes.*

Horn-nose Snake.—127 abdominal plates, 32 subcaudal scales. Olive brown, with blackish variegations, a row of pale dorsal spots, surrounded by black, and a waving pale band on the sides. This fierce and forbidding species, which has its denomination from two large and pointed processes on the tip of the nose, is supposed to inhabit the interior parts of Africa. 82 *Nasicornis.*

Megæra, or *Spear-headed Snake.*—224 abdominal plates, 83 *Megæra.*

Coluber. plates, and 68 subcaudal scales. Brown, with yellow variegations, flat cordate head, and a large orifice on each side, between the eyes and nostrils. Native of Martinico, whence it is frequently called *yellow Martinico snake*. Measures, when full grown, five or six feet, has very large fangs, and inflicts a dangerous wound.

84 *Naja.* *Spectacle Snake*, or *Cobra de Capello*.—193 abdominal plates, 60 subcaudal scales. "Its general length (says Dr Shaw), seems to be three or four feet, and the diameter of the body about an inch and a quarter: the head is rather small than large, and is covered on the fore part with large smooth scales; resembling, in this respect, the majority of innoxious serpents: the back part, sides, and neck, with smaller ovate scales; and the remainder of the animal, on the upper parts, with small, distinct, oval scales, not ill resembling the general form of a grain of rice. At a small distance beyond the head is a lateral swelling or dilatation of the skin, which is continued to the distance of about four inches downwards, where the outline gradually sinks into the cylindric form of the rest of the body. This part is extensile, at the pleasure of the animal; and, when viewed from above, while in its most extended state, is of a somewhat cordated form, or wider at the upper than at the lower part: it is marked above by a very large and conspicuous patch or spot, greatly resembling the figure of a pair of spectacles; the mark itself being white, with black edges, and the middle of each of the rounded parts black. This mark is more or less distinct in different individuals, and also varies occasionally in size and form, and in some is even altogether wanting. The usual colour of the animal is a pale ferruginous brown above, the under parts being of a bluish white, sometimes slightly tinged with pale brown or yellow: the tail, which is of a moderate length, tapers gradually, and terminates in a slender sharp-pointed extremity.

"This formidable reptile has obtained its Portuguese title of *cobra de capello*, or *hooded snake*, from the appearance which it presents when viewed in front in an irritated state, or when prepared to bite; at which time it bends the head rather downwards, and seems hooded, as it were, in some degree, by the expanded skin of the neck. In India it is everywhere exhibited publicly as a show, and is, of course, more universally known in that country than almost any other of the race of reptiles. It is carried about in a covered basket, and so managed by its proprietors as to assume, when exhibited, a kind of dancing motion; raising itself up on its lower part, and alternately moving its head and body from side to side for some minutes, to the sound of some musical instrument which is played during the time. The Indian jugglers, who thus exhibit the animal, first deprive it of its fangs, by which means they are secured from the danger of its bite."

The *cobra de capello* is one of the most formidable and dangerous of the serpent tribe, though it is devoured with impunity by the *viverra ichneumon*. Dr Russel describes ten varieties of this species, and enters into many curious details relative to the effects of its poison on dogs and other animals. He never knew it prove mortal to a dog in less than 27 minutes, nor to a chicken in less than half a minute. Hence its poison, fatal as it is, seems to be less speedy in its operation than that of the rattlesnake. Coluber.

Russellian Snake.—168 abdominal plates, 59 subcaudal scales. Brownish yellow; spots on the back acutely ovate, blackish, and edged with white; those on the sides smaller. About four feet long; native of India, and very poisonous. A chicken bitten in the pinion, by an individual of this species, was instantly infected, seized with convulsions, and expired in 38 seconds. Immediately after the chicken, a stout dog was bitten in the thigh. Within less than five minutes he appeared stupified; the thigh was drawn up, and he frequently moved it, as if in pain. He remained, however, standing, and ate some bread that was offered to him. In about 10 minutes the thigh became paralytic; in 15 minutes he entirely lost the use of it, and lay down howling, in a dismal manner, frequently licking the wound, and making, at intervals, ineffectual attempts to rise. In 19 minutes, after a short cessation, he again began to howl, moaned often, and breathed laboriously, till his jaws closed. The few succeeding minutes were passed, alternately, in agony and stupor; and, in 26 minutes after the bite, he expired. A second dog, of much smaller size, was next bitten, and expired in the space of six hours. A rabbit was next exposed to the bite, and died in less than an hour. After this, another chicken was bitten in the pinion, and expired in less than six minutes. These experiments were all made with the same snake, in the course of the same morning. 85 *Russellii.*

Crimson-sided Snake.—188 abdominal and 7 anal plates, 45 subcaudal scales. Violet black, with the abdomen and sides of a beautiful crimson, the plates margined with black. A singular and elegant species, with the proportions nearly those of the common English snake; poisonous; and a native of New Holland. 86 *Porphyriacus.*

Hæmachate Snake.—132 abdominal plates, 43 subcaudal scales. Red, clouded with white above, yellowish white beneath. Two feet or more in length; tail extremely short, and tapering to a point. Native of India; elegant, and poisonous. 87 *Hæmachates.*

Water Viper.—Brown above, banded with black and yellow beneath. "This serpent (says Catesby) is called, in Carolina, the *water rattlesnake*; not that it hath a rattle, but is a large snake, and coloured not much unlike the rattlesnake, and the bite said to be as mortal. This snake frequents the water, and is never seen at any great distance from it: the back and head are brown; the belly transversely marked with black and yellow alternately, as are the sides of the neck; the neck is small, the head large, and armed with the like destructive weapons as the rattlesnake. It is very nimble, and particularly dexterous in catching fish. In summer great numbers are seen lying on the branches of trees hanging over rivers, from which, at the approach of a boat, they drop down into the water, and often into the boat, on the men's heads. They lie in this manner to surprise either birds or fish, after which last they plunge, and pursue them with great swiftness, and catch some of a large size, which they carry on shore, and swallow whole. One of these I surprised swimming ashore, with a large catfish in its mouth. The tail is small towards the end, and terminates in a blunt horny point, about half an inch in length, and which, though harmless, 88 *Aquaticus.*

Coluber. harmleſs, is conſidered as of dreadful efficacy by the credulous vulgar, who believe, that the animal is able, with this weapon, not only to kill men and other animals, but even to deſtroy a tree by wounding it with it; the tree withering, turning black, and dying."

89 *Elegantiſſimus.* *Superb Snake.*—White, the head variegated with black, and the body marked above by a quintuple ſeries of ocellated red ſpots. About two feet long, and poiſonous.

90 *Argus.* *Argus Snake.*—Cheſnut brown, yellow beneath, and banded above, by tranſverſe rows of ocellated red ſpots. Above five feet in length; native of Arabia and Brazil, and very poiſonous.

91 *Javanicus.* *Java Snake.*—312 abdominal plates, 93 ſubcaudal ſcales. Gray, the head ſtriped with blue, and the body croſſed by blue ſtripes, with gold-coloured edges. Frequent in the rice fields of Java, where it grows to the length of nine feet; but, in the more elevated and wooded ſituations, it attains to a ſtill greater ſize, and is capable of devouring ſome of the larger animals. Splendid and innoxious.

92 *Natrix.* *Common*, or *Ringed Snake.*—170 abdominal plates, 60 ſubcaudal ſcales. Olive brown, with a black patch, accompanied by a yellow one, on each ſide of the neck, a row of narrow black ſpots down each ſide, and duſky abdomen.

This ſpecies is pretty generally diffuſed over Europe, and is not uncommon in our own iſland, affecting moiſt and warm woods, baſking or ſleeping in the ſunſhine, and becoming torpid in winter. The female depoſits a chain of from 12 to 20 eggs, about the ſize of thoſe of the blackbird, connected by bunches of a gluey matter, in dunghills, or warm receſſes, near ſtagnant waters. The young come forth in the following ſpring. The common ſnake reappears in March or April, when it caſts its ſkin ſo completely, that the ſpoil exhibits even the exterior pellicle of the eye. To adopt the language of Mr White, in his Naturaliſt's Calendar, "It would be a moſt entertaining ſight, could a perſon be an eye-witneſs to ſuch a feat, and ſee the ſnake in the act of changing his garment. As the convexity of the eyes in the ſlough is now inward, that circumſtance alone is a proof that the ſkin has been turned; not to mention that now, the preſent inſide is much darker than the outer. If you look through the ſcales of the ſnake's eye from the concave ſide, viz. as the reptile uſed them, they leſſen objects much. Thus it appears, that ſnakes crawl out of the mouth of their own ſloughs, and quit the tail part laſt, juſt as eels are ſkinned by a cookmaid. While the ſcales of the eyes are growing looſe, and a new ſkin is forming, the creature, in appearance, muſt be blind, and find itſelf in a very awkward and uneaſy ſituation."

This ſpecies occaſionally frequents the water, and preys chiefly on frogs, mice, ſmall birds, inſects, worms, &c. It is not only perfectly harmleſs, but even capable of being domeſticated. Mr White mentions, that he knew a gentleman who had one in his houſe quite tame. Though uſually as ſweet as any other animal, yet, whenever a ſtranger, or a dog or cat entered, it would begin to hiſs, and ſoon filled the room with an almoſt inſupportable odour. Mr Revett SheppHard of Caius college, Cambridge, had a common ſnake in his rooms near three months. "He kept it (ſays Mr Bingley) in a box of bran; and, during all that time, he never could diſcover that it ate any thing, although he frequently put both eggs and frogs, the favourite food of this ſpecies, into the box. Whenever he was in the room he uſed to let the animal out of its priſon; it would firſt crawl ſeveral times round the floor, apparently with a deſire to eſcape; and when it found its attempts fruitleſs, it would climb up the tables and chairs, and not unfrequently even up the chair of its owner as he ſat at his table. At length it became ſo familiar as to lie in a ſerpentine form on the upper bar of his chair: it would crawl through his fingers, if held at a little diſtance before its head, or lie at full length upon his table, while he was writing or reading, for an hour or more at a time. When firſt brought into the room, it uſed to hiſs and dart out its forked tongue; but in no inſtance emitted any unpleaſant vapour. It was, in all its actions, remarkably cleanly. Sometimes it was indulged with a run upon the graſs, in the court of the college; and ſometimes with a ſwim in a large baſon of water, which it ſeemed to enjoy very much. When this gentleman left the univerſity, he gave his bedmaker orders to turn it out into the fields, which, he believes, was done."

Black Snake.—186 abdominal plates, 92 ſubcaudal ſcales. Gloſſy black, with a very long ſlender body. Five or ſix feet long, and not venomous, though often confounded by the ignorant and the timid with the rattleſnake. Native of North America. Its ſpeed and activity, according to Brickell, are aſtoniſhing. Sometimes it will climb trees in queſt of the tree-frog, or, for other prey, glide at full length, along the ground: on other occaſions it preſents itſelf half erect, and appears to great advantage. It is ſo fond of milk, that it has been ſeen eating it out of the ſame diſh with children, though they often gave it blows with their ſpoons on the head when it was too greedy. It perſecutes rats with wonderful agility, purſuing them even to the roofs of barns and outhouſes, and is therefore a great favourite among the Americans. 93 *Conſtrictor.*

Faſciated or *Wampum Snake.*—Blue above, paler, and variegated with brighter blue beneath. Its colours reſemble thoſe of the ſtrings of Indian money, called *wampum*, compoſed of ſhells cut into regular pieces, and ſtrung with a mixture of blue and white. Native of Carolina and Virginia, ſometimes growing to the length of five feet, and perfectly innocent. 94 *Faſciatus.*

Blue Green Snake.—217 abdominal plates, 122 ſubcaudal ſcales. Bright blue green, with a purple tinge on the back, and whitiſh abdomen. A very beautiful ſpecies, about three feet long, harmleſs, and a native of Surinam. 95 *Viridiſſimus.*

Coach-whip Snake.—Brown, with pale abdomen; very long and ſlender, inoffenſive, and native of North America. It runs with extreme ſwiftneſs, in purſuit of flies, &c. and is very eaſily tamed. 96 *Flagellum.*

Ornamented Snake.—Habit long, and very ſlender; colour jet black, with white flower-ſhaped ſpots, and white abdomen. This very elegant ſpecies inhabits ſome of the Weſt India iſlands, and, according to Seba, is alſo found in Java and Ceylon. 97 *Ornatus.*

Domicella Snake.—118 abdominal plates, 60 ſubcaudal ſcales. A very elegant and harmleſs ſpecies, of a ſlender habit, with many jet-black croſs bands, and a blackiſh line on the abdomen. It is alleged that the Indian ladies ſometimes carry it in their boſoms. 98 *Domicella.*

Boaform

Coluber.

99 *Boæformis.* *Boaform Snake.*—252 abdominal plates, 62 ſubcaudal ſcales. Whitiſh, with brown variegations; white beneath, with very ſhort ſcuta, the under part of the tail variegated with black and white. Native of India, and ſo ſtrong, that it can numb the hand by wreathing round the arm. Its bite, however, is not poiſonous.

100 *Domeſticus.* *Domeſtic Snake.*—245 abdominal plates, 94 ſubcaudal ſcales. Gray, ſpotted with brown, and a double black ſpot between the eyes. Native of Barbary, where it is domeſticated for the purpoſe of deſtroying the ſmaller noxious animals.

101 *Faſciolatus.* *Faſciolated Snake.*—192 abdominal plates, 62 ſubcaudal ſcales. Cinereous, with whitiſh croſs bands, and glaucous abdomen. Native of India, and not poiſonous, as vulgarly believed.

102 *Lineatus.* *Lineated Snake.*—169 abdominal plates, 84 ſubcaudal ſcales. This beautiful and inoffenſive ſpecies, though ſubject to conſiderable variety of aſpect, may be generally diſtinguiſhed by its bluiſh-green ground, and three or five brown linear ſtripes, of which that in the middle is broadeſt. It inhabits ſeveral parts of India, and is from two to three feet long.

103 *Elegans.* *Elegant Snake.*—202 abdominal plates, 146 ſubcaudal ſcales. Yellowiſh gray, with three broad reticulated blackiſh bands, a broad fillet on the abdomen, and the head freckled with brown. Length about two feet; tail very long and narrow. Native of South America. Well figured by Seba.

104 *Mycteri-zans.* *Long-ſnouted Snake.*—192 abdominal plates, 167 ſubcaudal ſcales. Slender, with a ſharp-pointed ſnout; colour graſs green, with a yellow line on each ſide of the abdomen. About three feet and a half in length, and half an inch in diameter. Native of North America, where it is often ſeen on trees, running very quickly in purſuit of inſects.

105 *Abætulla.* *Irideſcent Snake.*—163 abdominal plates, 150 ſubcaudal ſcales. Tinge blue green, and gilded, accompanied with irideſcent hues, with pale abdomen, and black ſtreak acroſs the eyes. From three to four feet long. Native of India, one of the moſt beautiful of the ſerpent tribe, and perfectly innocent.

To exhibit even ſhort definitions of the other ſpecies included in the genus *Coluber*, would extend this article to a diſproportionate length. Of moſt of the omitted ſorts, however, we may obſerve, that the hiſtory is either not particularly intereſting, or too little known.

106 HYDRUS.

Gen. 4. HYDRUS, *Water-ſnake.*

107 Characters. Body ſlender in front, gradually thickening, ſcaled; tail compreſſed.—This is a genus of recent inſtitution, compriſing thoſe ſpecies of ſerpents which naturally inhabit the water.

108 *Colubrinus.* *Colubrine Hydrus.*—Lead-coloured, with black ſurrounding bands. Ordinary length about two feet and a half. The fangs are very ſmall in proportion to the ſize of the animal. It is the *coluber laticaudatus* (Lin.), and inhabits the American and Indian ſeas.

109 *Faſciatus.* *Faſciated Hydrus.*—Long and ſlender; black, longitudinally marked by yellowiſh white pointed bands; upwards of two feet in length, poiſonous, and native of the Indian ſeas.

110 *Spiralis.* *Spiral Hydrus.*—Yellowiſh, with brown bands; body ſpirally twiſted. A rare and elegant ſpecies, thus deſcribed by Dr Shaw.

Hydrus.

"Its length is about two feet, and its habit ſlender; the body much compreſſed throughout; the back riſing into a very ſharp carina; the abdomen being alſo carinated, but having a flattened edge of ſcales ſomewhat wider than the reſt, and meaſuring about the fifteenth of an inch in diameter; the head is ſmall, and covered with large ſcales; the mouth wide; the ſcales on the whole animal moderately ſmall, ovate, and ſlightly carinated; the ground colour is yellow, barred in a beautiful manner from head to tail with deep cheſnut brown or blackiſh faſciæ, each widening on the abdomen, and thus forming a highly diſtinct and handſome pattern when viewed on each ſide, ſeeming to conſtitute ſo many large, round, yellow ſpots on a blackiſh ground: the back, at about the middle, is marked along its upper part with a row of rather large, round, blackiſh ſpots, ſituated between the faſciæ, and ſo placed as to be in ſome parts on one ſide, and in others on the oppoſite ſide of the dorſal carina, while ſome few are ſeated on the middle of the ridge itſelf: this variegation is continued to the tail, which is about an inch and three quarters long, black or deep brown, with a few yellow patches towards its beginning; it is remarkably broad for the ſize of the animal, and very thin on the edges, ſo as to be ſemitranſparent on thoſe parts. The moſt remarkable circumſtance in this ſnake is the ſingular obliquity of its form, the body in different parts being alternately flatter on one ſide than the other, and the pattern completely expreſſed on the flattened ſide only; the other, or more convex ſide, being unmarked by the round ſpots; and lying as it were beneath, thus conſtituting ſeveral alternately ſpiral curves: this ſnake ſeems of an unuſually ſtiff and elaſtic nature, and the carina on the back is ſo ſharp as to ſurpaſs in this reſpect every other ſpecies of ſerpent. The ſpecimen is in the Britiſh Muſeum; but its particular hiſtory ſeems to be unknown."

Black-backed Hydrus.—Head oblong, body black above, and yellowiſh beneath; tail ſpotted. *Anguis platma*, Lin. Native of the Indian ſeas, and common about the coaſts of Otaheite, where it is uſed as an article of food. 111 *Bicolor.*

Great Hydrus.—Livid, with brown bands, and hexagonal ſcales abruptly carinated. Upwards of three feet long. Native of the Indian ſeas. Its habits little known. 112 *Major.*

The other *hydri* are, *caſpius*, *gracilis*, *cœruleſcens*, *curtus*, *atrocœruleus*, *cinereus*, *piſcator*, and *paluſtris*.

Gen. 5. LANGAYA. 113 LANGAYA.

Abdominal plates, caudal rings, and terminal ſcales. 114 Characters.

There is only one ſpecies known, viz.

Snouted Langaya.—184 abdominal plates, 42 caudal rings; but theſe numbers are ſubject to vary. Length between two and three feet, and diameter about ſeven lines, in the thickeſt part of the body. Colour of the upper parts reddiſh, or violet, of the under parts pale or whitiſh. Teeth like thoſe of the viper. Native of Madagaſcar, where it is much dreaded. 115 *Naſuta.*

Gen. 6. ACROCHORDUS. 116 ACROCHORDUS.

Body completely covered with warts. 117 Character.

Javan Acrochordus.—This reptile was diſcovered in a 118 *Javanicus.*

Acrochordus. a pepper field, in the iſland of Java, in 1784. It meaſured eight feet in length, and 10 inches in diameter, in the thickeſt part of the body. It was blackiſh above, whitiſh beneath, and marked by duſky ſpots on the ſides. Five young ones, full formed, and each nine inches long, were found in the belly. The Chineſe eſteem it as a food.

The *dubius* and *faſciatus* are ſo nearly allied to the preceding, that they may be regarded only as varieties.

119 Anguis.

Gen. 7. Anguis, *Slow-worm.*

120 Characters. Furniſhed with abdominal and ſubcaudal ſcales. Conformation reſembling that of ſome of the lizard tribes, the body being compoſed of a ſeries of moveable rings, which are eaſily broken and eaſily reproduced. A very harmleſs, and rather ſluggiſh genus.

121 *Fragilis.* *Common Slow-worm*, *Blind-worm*, or *Long Cripple.*—135 abdominal, and the ſame number of ſubcaudal ſcales. Black, yellowiſh aſh, or rufous gray; belly black, ſides ſtreaked with black and white, tail long and obtuſe, ſcales ſmall, ſoft, and compact. The colouring is ſubject to conſiderable variety. Length, from 10 to 12 inches, or more. Common in Europe and Siberia, frequenting hollow ways, woods, paths, rubbiſh, &c. Viviparous, ſubject to hybernation, living on worms and inſects, and perfectly innoxious. It is obſerved of this ſpecies, as well as of ſome others, that, if ſtruck with any degree of violence, the body not only breaks abruptly on the ſtruck part, but even ſometimes, at different places, and that the fragments will live a long while afterwards. Though of very gentle diſpoſitions, the blind worm, like many of the family of ſerpents, refuſes to eat in captivity, unleſs it is tamed. M. Daudin mentions that he kept one two months and a half, during all which time it conſtantly refuſed nouriſhment of every kind.—It is preyed on by various birds, hedgehogs, ſnakes, frogs and toads.

According to Dr Shaw, the *Blue-bellied Snake*, or *Aberdeen Slow-worm* (*A. Eryx* Lin.) is only a variety of the *Fragilis*. It occurs in Scotland and North America.

122 *Scytale.* *Painted Slow-worm.*—240 abdominal, and 13 ſubcaudal ſcales. Varies much in colour, but is generally orange, with black blotches; ſometimes black and white, ſometimes pale roſe and black, paler beneath, and elegantly faſciated with bars of deep black. Native of South America, particularly of Cayenne and Surinam. In preſerved ſpecimens, the orange hue is very apt to fade into white.

123 *Corallinus.* *Coral Slow-worm.*—Ground colour pale red, with coral red variegations. A very beautiful ſpecies, native of Brazil.

124 *Ventralis.* *Glaſs Slow-worm.*—127 abdominal, 222 ſubcaudal ſcales. Blackiſh green, ſpeckled with yellow, with a very ſhort yellow abdomen, a deep furrow on each ſide of the body, from the corners of the mouth to the vent, and a tail more than twice the length of the abdomen. Native of North America, and not uncommon in Carolina, where it is called the *Glaſs Snake.* 'A ſmall blow of a ſtick', ſays Cateſby, 'cauſes the body to ſeparate, not only at the place ſtruck, but at two or three other places, the muſcles being articulated quite through the vertebræ.'

Snouted Slow-worm.—218 abdominal, and 12 ſubcaudal ſcales. Greeniſh black above, yellow beneath, ſnout elongated, tail terminating in a horny tip. Length about a foot. Native of Surinam. Acrochordus. 125 *Naſuta.*

Jamaica Slow-worm, or *Silver Snake.*—Pale brown, with a ſilvery gloſs on the ſcales; the body, which rarely exceeds ſixteen inches in length, gradually thickening; and the tail abruptly ſubacuminate. 126 *Jamaicenſis.*

The other ſpecies are, *Meleagris*, *Ater*, *Maculata*, *Leucomelas*, *Rufa*, *Reticulata*, and *Clivioca.*

Gen. 8. Amphisbæna.

127 Amphisbæna.

Body nearly cylindrical, with annular diviſions round the body and tail. The ſkin divided in a longitudinal direction, by ſtraight lines, forming with the wings ſo many ſquare or parallelogrammic ſcales. A harmleſs and oviparous genus, native of the warmer regions of the new world, and not of Ceylon, as Seba has erroneouſly aſſerted. 128 Characters.

White Amphiſbæna.—223 abdominal, and 16 caudal, ſcaly rings. Pale white, verging on yellowiſh, and unſpotted. Two feet or more in length, and of a conſiderable proportionate thickneſs. Is found in woods, in Surinam, &c. where it preys chiefly on inſects and worms. 129 *Alba.*

Fuliginous Amphiſbæna.—200 abdominal, and 30 caudal, ſcaly rings. Differs from the preceding chiefly by its black and white variegations. Common in Cayenne, Surinam, and Brazil; but Linnæus, and other naturaliſts, miſled by Seba, have falſely repreſented it as a native of Libya, the iſland of Lemnos, &c. 130 *Fuliginoſa.*

Gen. 9. Cæcilia.

131 Cæcilia.

Body cylindrical, wrinkles on the ſides of the body and tail. 132 Characters.

Eel-ſhaped Cæcilia.—Anguilliform, with diſtant wrinkles, and a very ſmall cirrhus beneath each noſtril. The ſkin of the whole body, when cloſely inſpected, is found to be covered with very minute granules. About 18 inches long, native of South America, and deſtitute of poiſon fangs. 133 *Tentaculata.*

White-ſided Cæcilia.—340 wrinkles on the body, 10 on the tail. Brown, with very cloſe wrinkles, and a whitiſh lateral line. Native of South America. 134 *Glutinoſa.*

Slender Cæcilia.—Brown, ſhaped like an earth-worm, nearly 14 inches long, and one fifth of an inch in diameter. The upper jaw is longer than the lower, and the teeth are ſo ſmall, as not to be diſtinctly viſible. 135 *Gracilis.*

We cannot cloſe our deſcriptive catalogue of the ſerpent tribe, without remarking, that the ſubject ſtill requires elucidation; that the Linnæan characters are not always to be ſtrictly interpreted; and that ſeveral ſpecies appear to have been overlooked, merely becauſe the number of their ſcales could not be aſcertained.

Miſcellaneous Obſervations.

The formidable aſpect of ſome ſerpents, and the poiſonous qualities of others, have probably inſpired mankind, in every age, with ſentiments of terror and awe. In the rude periods of ſociety, fear is akin to devotion, and Bartram informs us, that the rattleſnake is worſhipped by ſeveral of the ſavage tribes in North America. On the 136 Worſhip of ſerpents.

Miſcellaneous Obſervations.

the Gold and Slave coaſts, a ſtranger, on entering the cottages of the natives, is often ſurpriſed to ſee the roof ſwarming with ſerpents, that cling there without moleſting, and unmoleſted by, the natives. But his ſurpriſe will increaſe as he advances farther ſouthward, to the kingdom of Widah, when he finds that a ſerpent is the god of the country. This animal, which travellers deſcribe as a huge overgrown creature, has its habitation, its temple, and its prieſts. Theſe laſt impreſs the vulgar with an opinion of its virtues; and numbers are daily ſeen to offer, not only their goods, proviſions, and prayers, but even their wives and daughters, at the ſhrine of their hideous deity. The prieſts readily accept the proffered females, and after ſome days of *penance*, return them to their ſuppliants, much benefited by the ſerpent's ſuppoſed embraces.

137 Enchantment of ſerpents.

The ancients ſeem to have been aware, that certain ſpecies of ſerpents were attracted by muſical ſounds, and have celebrated the *Pſylli* and *Marſi*,

Ad quorum cantus mites jacuêre ceraſtæ.

At this day, there are jugglers in India, who train ſnakes to move and geſticulate to the ſound of the flute; and we have already mentioned, that they tame the *Cobra de Capello*, and exhibit it to the populace. When the ſnakeman firſt provokes the creature to attack him, he covers his hand with an earthen jar, which he uſes as a ſhield, and thus hurts the animal's mouth, and knocks it backwards, whenever it attempts to bite. He continues this exerciſe for an hour, or longer, taking care, however, not to fatigue the ſnake too much, nor to hurt it ſo as to deter it from returning to the attack. Thus, the animal is gradually taught to raiſe itſelf, on preſenting a jar, a ſtick, or even the bare hand, the motions of which it follows with its head, without daring to bite, leſt it ſhould again wound its mouth. The juggler accompanies this exerciſe with ſinging, ſo that what is really a defenſive war on the part of the ſerpent, has the appearance of a dance. To render this exhibition leſs dangerous, the fangs are ſometimes removed; but more frequently the ſnake is deprived of its poiſon, by being daily irritated to bite on a piece of cloth, or any ſoft ſpongy ſubſtance; nay, they have the addreſs and courage to preſs its head, and thus provoke it, while biting, to make it ſeize the cloth with greater violence, and more effectually expreſs its poiſon.

The Egyptian enchanters, however, appear to have recourſe to more ingenious and myſterious artifices. "They take the moſt poiſonous vipers," ſays Haſſelquiſt, "with their bare hands, play with them, put them in their boſoms, and uſe a great many more tricks with them, as I have often ſeen. I have frequently ſeen them handle thoſe that were three or four feet long, and of the moſt horrid ſort. I inquired and examined if they had cut out the viper's poiſonous teeth; but I have with my own eyes ſeen they do not. We may, therefore, conclude, that there are to this day Pſylli in Egypt; but what art they uſe is not eaſily known. Some people are very ſuperſtitious, and the generality believe this to be done by ſome ſupernatural art which they obtain from inviſible beings. I do not know whether their power is to be aſcribed to good or evil; but I am perſuaded that thoſe who undertake it uſe many ſuperſtitions.

"The circumſtances relating to the faſcination of ſerpents in Egypt, related to me," he continues, "were principally, 1. That the art is only known to certain families, who propagate it to their offspring. 2. The perſon who knows how to faſcinate ſerpents, never meddles with other poiſonous animals, ſuch as ſcorpions, lizards, &c. There are different perſons who know how to faſcinate theſe animals; and they again never meddle with ſerpents. 3. Thoſe that faſcinate ſerpents, eat them both raw and boiled, and even make broth of them, which they eat very commonly amongſt them; but in particular, they eat ſuch a diſh when they go out to catch them. I have been told, that ſerpents fried or boiled are frequently eaten by the Arabians both in Egypt and Arabia, though they know not how to faſcinate them, but catch them either alive or dead. 4. After they have eaten their ſoup, they procure a bleſſing from their ſcheik (prieſt or lawyer), who uſes ſome ſuperſtitious ceremonies, and amongſt others, ſpits on them ſeveral times with certain geſtures. This manner of getting a bleſſing from the prieſt is pure ſuperſtition, and certainly cannot in the leaſt help to faſcinate ſerpents; but they believe, or at leaſt perſuade others, that the power of faſcinating ſerpents depends upon this circumſtance."

On this ſubject, the celebrated Mr Bruce in his travels to diſcover the ſource of the Nile, is alſo minute and explicit. Among other paſſages, we ſhall be content to quote the following.

"I will not heſitate to aver, that I have ſeen at Cairo (and this may be ſeen daily without trouble or expence) a man who came from above the catacombs, where the pits of the mummy birds are kept, who has taken a ceraſtes with his naked hand from a number of others lying at the bottom of the tub, has put it upon his bare head, covered it with the common red cap he wears, then taken it out, put it in his breaſt, and tied it about his neck like a necklace; after which it has been applied to a hen, and bit it, which has died in a few minutes; and to complete the experiment, the man has taken it by the neck and beginning at his tail, has eaten it as one would do a carrot or a ſtock of celery, without any ſeeming repugnance."

"I can myſelf vouch, that all the black people in the kingdom of Sennaar, whether Funge or Nuba, are perfectly armed againſt the bite of either ſcorpion or viper. They take the ceraſtes in their hands at all times, put them in their boſoms, and throw them to one another as children do apples or balls, without having irritated them, by this uſage, ſo much as to bite. The Arabs have not this ſecret naturally; but from their infancy they acquire an exemption from the mortal conſequences attending the bite of theſe animals, by chewing a certain root, and waſhing themſelves (it is not anointing) with an infuſion of certain plants in water."

The teſtimony of Savary is not leſs preciſe. At the feaſt of Sidi Ibrahim, he ſaw a troop of people, ſeemingly poſſeſſed, with naked arms and fierce looks, holding in their hands enormous ſerpents, which twined round their body, and endeavoured to eſcape. But theſe enchanters avoided the bite, by graſping the animals ſtrongly by the neck, then tore them with their teeth, and ate them alive, while the blood ſtreamed from their mouth.

Miscellaneous Observations. The circumstance of seizing them fast by the neck, accords with the concluding part of the ensuing relation of Denon.

"Having been always curious to observe the means by which some men command the opinions of others, I regretted that I was not at Rosetta, at the procession of the feast of Ibrahim, in which the convulsions of the Psylli form the most entertaining part, to the populace, of this religious ceremony. To make up for my loss, I addressed myself to the chief of the sect, who was keeper of the *Okel* or tavern of the Franks; I flattered him; and he promised to make me a spectator of the exaltation of one of the Psylli, as soon as he should have *inspired* him. From my curiosity he thought I was likely to become a proselyte, and he proposed to initiate me, which I accepted; but when I learned that in the ceremony of initiation, the grand master spits in the mouth of the neophyte, this circumstance cooled my ardour, and I found that I could not prevail on myself to submit to such a point of probation. I therefore gave my money to the chief, and the high priest promised to let me see one of the inspired.

"They had brought with them some serpents, which they let loose from a large leather sack in which they were kept, and by irritation made them erect their bodies, and hiss. I remarked that the light was the principal cause of their anger; for as soon as they were returned into the sack, their passion ceased, and they no longer endeavoured to bite. They had a particular quality, which was that when angry, the neck for six inches below the head was dilated to the size of one's hand. I soon saw, that I had no greater reason to dread the bite of these serpents than their masters had; for having well remarked that the Psylli, while they were threatening the animal with one hand, seized it on the back of the head with the other, I did the same with one of the serpents with equal success, though much to the indignation of these mysterious quacks."

We have likewise heard of people in Europe who allowed themselves to be bitten by vipers, with impunity, to the great astonishment of the spectators. They first made the animal eat of a prepared paste, which closed the apertures in the fangs, and thus precluded the discharge of the poison.

138 Serpentine poison. Various and contradictory opinions, conjectures, and fictions, have been advanced relative to the nature, action, and cure of serpentine poison. Among the vulgar errors connected with this subject, we may reckon the *sting*, fixed in the serpent's tail, and the flowing of venom from the *black forked tongue*, and from the *teeth* in general.

Towards the end of the 17th century, Ferdinand II. Grand Duke of Tuscany, invited Steno, Redi, and some other eminent men of science, to his court, with a view to investigate the history of this important phenomenon in the animal economy. Redi, in particular, instituted a great variety of experiments, and arrived at some useful discoveries. When he either caused a living viper to bite a dog, or wounded the latter with the teeth of one newly dead, the event was the same. If the bite was repeated, its effect became weaker, and, at length was lost, the poison contained in the vesicle being exhausted. He observed, that when the teeth of serpents were extended to bite, they were moistened over with a certain liquor, and that when the vesicle at the base was pressed, a drop of poison flowed to the point of the fang. When the poison thus flowing from the vesicle was received in soft bread, or a sponge, an animal bitten by the serpent received no more harm from the wound than from the pinch of a needle, till after a few days, when the venom was secreted afresh; but when an animal was wounded with the point of a needle dipped in the poison, it was tormented with the same pains as if it had been bitten by the viper itself. Having preserved some of this poison in a glass, and totally evaporated the moisture in the sun, when the residuum was diluted with water, Redi found, to his great surprise, that it had the same effect as when recent. But the boldness of Jacob Sozzi, a viper charmer, excited the astonishment of the learned. As they happened in the prince's presence to talk of the certain death which would attend the swallowing of viperine poison, Sozzi, confiding in his art, drank a considerable portion of it without hesitation, and with the same safety as if he had drunk so much water. This result, which so much startled the grand duke and his philosophic associates, was not unknown to the ancients, as may be inferred from these lines in Lucan:

Noxia serpentum est admisso sanguine pestis:
Morsu virus habent et fatum dente minantur,
Pocula morte carent.

The ingenious and indefatigable Fontana made no fewer than 6000 experiments on this interesting subject. Of these, our limits will not permit us to enumerate the results. In consequence, however, of his multiplied and persevering researches, we are enabled to state, that this poison is not fatal to all animals; that it kills neither vipers, snakes, blind-worms, snails, nor leeches; that it acts very slightly on tortoises; that it is neither an acid nor an alkali; that it has no determined savour, and that it leaves in the mouth merely a sensation of astringency and stupor. It long retains its virulence in the cavity of the tooth, whether the latter be separated or not from its socket; but when dried and kept in an exposed situation, it loses its deleterious qualities in less than a year. Hence the propriety of caution in examining vipers that are stuffed or preserved in spirits, and in making use of clothes that have been bitten by them. Fontana has also proved that the poison of the viper is not uniformly fatal except to very small animals, and that it is more dangerous to the larger sorts, according to the quantity of virus secreted, the frequency of the bites, the different parts of the body on which they have been inflicted, and probably also, the higher temperature of the atmosphere. A sparrow dies in five or eight minutes, a pigeon in eight or twelve, a cat sometimes recovers, and a sheep very often; so that a man has little reason to dread the consequences of a single bite in the climate of Italy, and still less so in France or Great Britain. The hundredth part of a grain of poison applied to a muscle will kill a sparrow, whereas six times that quantity are required to kill a pigeon. According to this estimate, about three grains should prove fatal to a man, and 12 to an ox. But the vesicles of an ordinarily sized viper seldom contain more than two grains of poison, and even that quantity is not exhausted till after repeated bites. The poison is of a gummy consistency, and seems to act by destroying the irritability of the muscular fibre,

Miscellaneous Observations.

fibre, and introducing into the fluids a principle of putrefaction. It may be swallowed with impunity, provided there be no wound in the mouth; but if introduced into the blood, the most violent and convulsive agonies ensue, the sanguiferous system becoming coagulated, and the whole animal frame relaxed. Hence, powerful sudorifics, as the flesh of the viper itself, of snakes and lizards, which contain a large proportion of ammoniacal soap, the volatile alkali, and its various preparations, with numerous plants which excite copious perspiration, have been recommended, and often successfully used as antidotes, especially when their exhibition has been preceded by a tight ligature immediately above the wound, and by scarification and caustics.

On the effects and cure of the poison of snakes, some valuable observations and reflections occur in Dr Russell's splendid work on Indian serpents. The judicious author remarks, that when the poison is applied to brute animals, its progress is often so very rapid as hardly to leave time for the operation of medicine, or the application of any means whatever, with a probability of success. When the progress is slower, should the remedy be administered before unequivocal symptoms have removed all doubt of the poison having taken effect, recovery may be ascribed to the medicine given, whilst, in reality, no malady existed; and if deferred till doubts are removed, the remedy which, if applied in time might have proved efficacious, may be unjustly regarded as useless. Besides, it is well known that a bite of the most noxious snake does not constantly prove fatal, and that even some of the more tender animals, without the use of any remedy, recover in cases where the symptoms are apparently very formidable. These symptoms, in the bodies of different animals are very much alike, and proceed nearly in the same order of progression, though with different degrees of rapidity.

The American Indians either suck the wound, or apply to it chewed tobacco, or make several incisions around it, which they fill with gunpowder, and then fire it off. During the progress of the cure they have likewise recourse to several pounded and bruised plants, as to some of the species of *lactuca*, the root of *prenanthes alba*, the stems and leaves of a species of *helianthus*, and in desperate cases the radical bark of the tulip-tree. In general they are partial to the use of the syngenesious plants, and to the bark of the trunk and roots of various trees.

The experiments of Bernard de Jussieu, Lebeau, Sonnini, and Bosc, seem to have established that, of all known remedies for the bite of the viper and the rattlesnake, the most efficacious are, the volatile alkali, or *eau de luce*, with suction and scarification of the recent wound.

In addition to these methods of cure, we shall quote the prescription of Dr Moseley, who spent 12 years in the West Indies.

"The bites and stings of all venomous animals are cured by the same local means, which are very simple if they were always at hand. The injured part must be instantly destroyed or cut out. Destroying it is the most safe, and equally certain; and the best application for that purpose is the *lapis infernalis*, or butter of antimony. These are preferable to a hot iron which the ancients used, because a hot iron forms a crust, which acts as a defence to the under parts instead of destroying them. The *lapis infernalis* is much better than any other, as it melts and penetrates during its application. The bitten part must be destroyed to the bottom, and where there is any doubt that the bottom of the wound is not sufficiently exposed, butter of antimony should be introduced to it on the following day, as deep as possible; and incisions should be made to lay every part open to the action of these applications. Besides destroying, burning, or cutting out the part, incisions should be made round the wound, to prevent the communication of the virus. The wound is to be dressed for some time with poultices, to assuage the inflammation caused by the caustics; and afterwards with acrid dressings and hot digestives to drain the injured parts.

"Where the above-mentioned caustics cannot be procured, corrosive sublimate, oil of vitriol, aquafortis, spirit of salt, common caustic, or a plaster made of quicklime and soap, may be applied to the wound. Gunpowder laid on the part and fired, has been used with success. When a person is bitten remote from any assistance, he should make a tight ligature above the part until proper application can be made. The Spanish writers say, that the *habilla de Carthagena*, or Carthagena bean, is a specific for poisonous bites taken inwardly.

Dr Moseley then proceeds to state the ample testimony of Ulloa in favour of this bean, which is found in great abundance in the West India islands, under the name of *antidote* or *cocoon antidote*. "I have been informed (adds he) by some intelligent Indians, that any of the red peppers, such as bird pepper or bell pepper, or what is called *Cayenne pepper*, powdered, and taken in a glass of rum, as much as the stomach can possibly bear, so as to cause and keep up for some time great heat and inflammation in the body, and a vigorous circulation, will stop the progress of the poison of serpents, even after its effects are visible; and that the bitten part only afterwards mortifies and separates, and that the patient, with bark, wine, and cordials, soon recovers."

139 Preservation of serpents.

The naturalist who collects serpents for the purpose of preserving them in his cabinet, should have recourse to various precautions, which, though several of them are sufficiently obvious, are, at the same time, too often neglected. In general the hurtful sorts are caught with the greatest safety and dexterity by natives of the country in which they abound. The want of the head in many of the larger stuffed specimens from Guiana, &c. renders them of little value in a scientific point of view, and is the result of superfluous trouble to travellers who send them to Europe in this mutilated condition. Collectors, therefore, should carefully instruct their agents to preserve this part of the animal. As these larger specimens cannot easily be prepared without an incision in the skin, it will be of consequence to make this incision on the side, beginning at the termination of the plates, and not cutting across them, as is too often done, to the great prejudice of distinct classification. When the skin is once stripped, it may be carefully rolled up, up, and stuffed in the preparation room in the usual manner.

The smaller species of serpents may be kept in prepared spirits. Pure alcohol and spirituous liquors, especially when not reduced by water, frequently affect the most

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moſt brilliant animal colours. Thus, in the ordinary cabinet liquors, the fine red of the hæmachate ſnake degenerates into a dark brown, ſcales of a bright green or blue become ſomewhat pale, yellow always whitens, and orange changes to red or pale. White, brown, black, purple, mother of pearl, and metal-coloured ſcales are not liable to change. The following is an approved recipe for preſerving the various colours of ſerpents entire.

Take very pure ſpring water, ſaturate it with alum, then mix with it about one-fifth of its bulk of very limpid ſpirit of wine, paſs the mixture through a paper ſtrainer, and keep the liquor well corked up in bottles, in ſome cool and ſhady ſituation. Immerſe the animal which you wiſh to preſerve in a veſſel filled with this liquor, and allow it to remain in it 24 hours. The veſſel and its included liquor ſhould be reſerved for this preliminary proceſs. Then remove the reptile into a cylindrical veſſel of fine glaſs, filled to three-fourths of its height with the liquor above deſcribed, and cloſed with a glaſs cover. Lute the latter with maſtic and hogs greaſe; put the veſſel on a ſhelf that is ſheltered from heat and the ſolar rays; and at the end of two months, if the maſtic be dry, and you wiſh the jar to remain cloſed, paint the luting with an oil colour; but if you intend to open it frequently, uſe only the hogs greaſe.

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Reptiles may alſo be conveniently preſerved according to the method indicated by Chauſſier, in the *Bulletin des Sciences*, (for Prairial, year 10, N° 63.), without the previous trouble of preparing the ſkin. All that is required, is to ſtuff the cavities with cotton, and to immerſe the body in diſtilled water, ſaturated with ſuperoxygenated muriate of mercury; and when it has ſufficiently imbibed the ſaline ſolution in all its parts, to allow it to dry ſlowly in a well aired ſituation, ſcreened from the ſun and duſt. All the parts of the animal harden, and are thus defended from the voracity of inſects, and corruption of every kind.

EXPLANATION OF PLATES CCCLXXI, CCCLXXII, CCCLXXIII, AND CCCLXXIV.

Fig. 1. Carinated Scale.
— 2. Plain Scale.
— 3. Tail of Coluber Snake.
— 4. Tail of Boa.
— 5. Fang or Tooth through which the poiſon is conveyed.
Fig. 6. The head of poiſonous ſnake furniſhed with fangs, *a a a a*.
Fig. 7. The head of innoxious ſnake without fangs.
— 8. *Crotalus Horridus*, Banded Rattle-Snake.
— 9. *Boa Conſtrictor*.
Fig. 10. *Coluber Berus*, Common Viper.
— 11. —— *Ceraſtes*.
— 12. —— *Laticaudatus*, Colubrine Hydrus.
— 13. *Langaya Naſuta*, Snouted Langaya.
— 14. *Acrochordus Javanicus*, Javan Acrochordus.
Fig. 15. *Anguis Corallinus*, Coral Slow-worm.
— 16. *Amphiſbæna Alba*, White Amphiſbæna.
— 17. ——— *Fuliginoſa*, Fuliginous Amphiſbæna.
Fig. 18. *Cæcilia Tentaculata*, Eel-ſhaped Cæcilia.

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A. Bell Prin. Wal. Sculptor fecit.

OPHIOLOGY. Plate CCCLXXII.

Fig. 10.

Fig. 11.

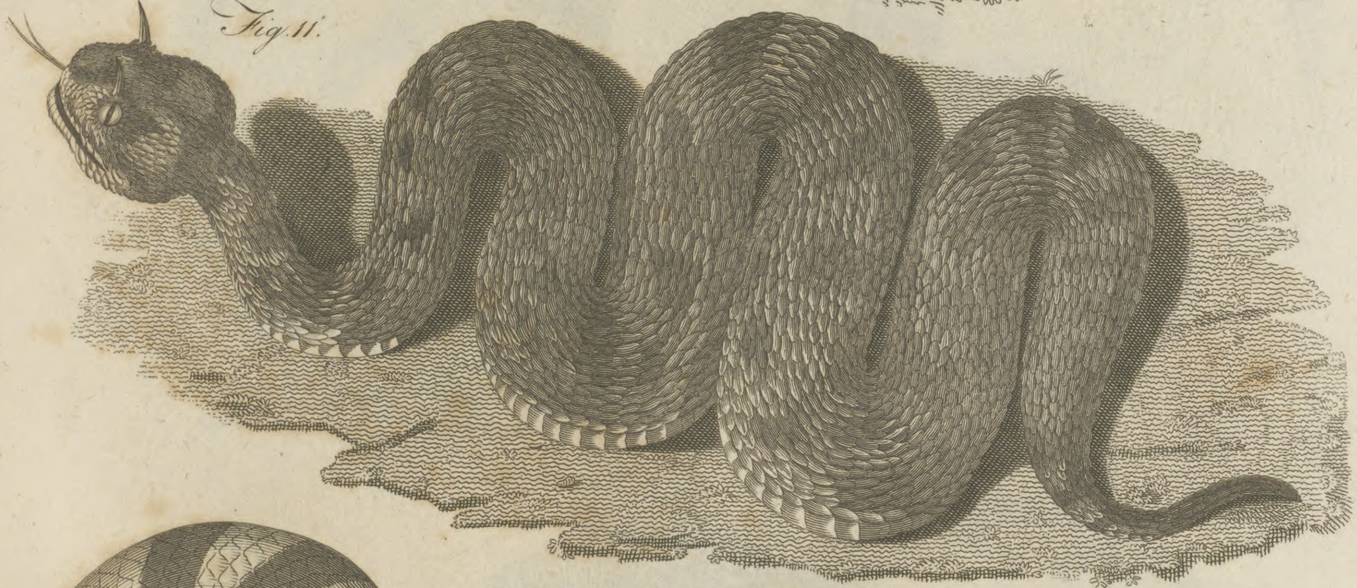

Fig. 12.

A.Bell Prin. Wal. Sculptor fecit.

Fig. 13.

Fig. 14.

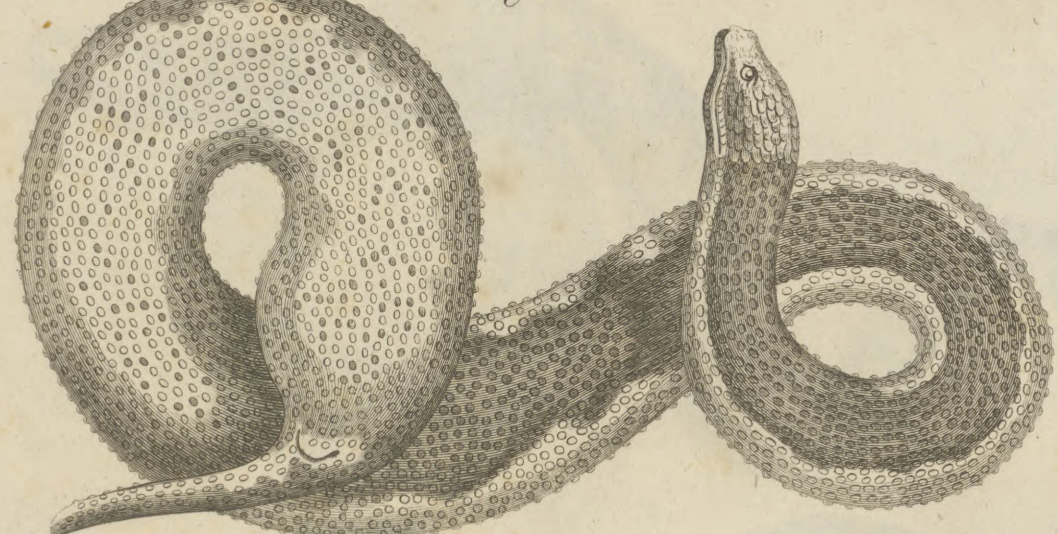

Fig. 15.

A. Bell Prin. Wal. Sculptor fecit.

Fig. 16.

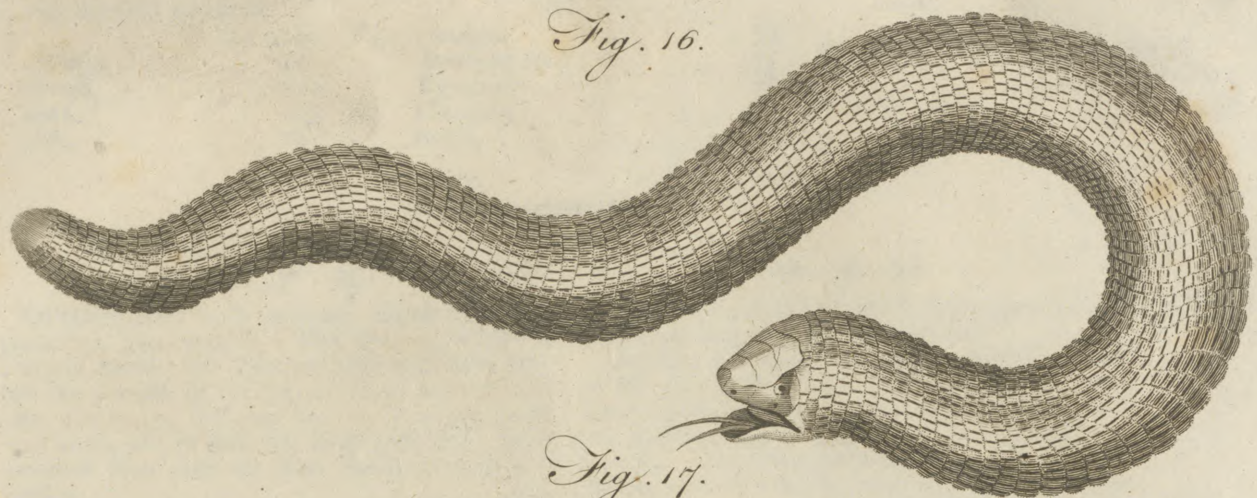

Fig. 17.

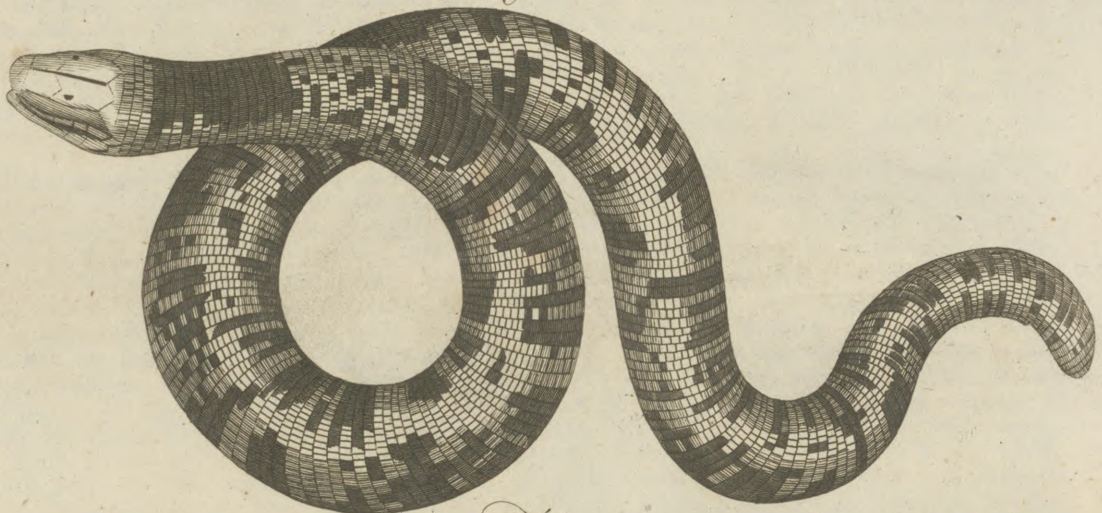

Fig. 18.

A. Bell Prin. Wal. Sculptor fecit

OPHIOMANCY, in antiquity, the art of making predictions from ſerpents. Thus Calchas, on ſeeing a ſerpent devour eight ſparrows with their dam, foretold the duration of the ſiege of Troy: and the ſeven coils of a ſerpent that was ſeen on Anchiſes's tomb, were interpreted to mean the ſeven years that Æneas wandered from place to place before he arrived at Latium.

OPHIORHIZA, a genus of plants belonging to the pentandria claſs, and in the natural method ranking under the 47th order, *Stellatæ*. See BOTANY *Index*.

OPHIOXYLON, a genus of plants belonging to the polygamia claſs, and in the natural method ranking with thoſe of which the order is doubtful. See BOTANY *Index*.

1 Different hypotheſes reſpecting the ſituation of Ophir.

OPHIR, a country mentioned in Scripture, from which Solomon had great quantities of gold brought home in ſhips which he ſent out for that purpoſe; but where to fix its ſituation is the great difficulty, authors running into various opinions on that head. Some have gone to the Weſt, others to the Eaſt Indies, and the eaſtern coaſt of Africa, in ſearch of it.—Mr Bruce, the celebrated Abyſſinian traveller, has diſplayed much learning and ingenuity in ſettling this queſtion of Biblical hiſtory. To the ſatisfaction of moſt of his readers he has determined Ophir to be Sofala, a kingdom of Africa, on the coaſt of Moſambique, near Zanguebar (ſee SOFALA). His reaſons for this determination are ſo generally known, that it would be improper to repeat them here at length; becauſe ſuch as are not already acquainted with them may conſult his book, which has been long in the hands of the public. He juſtly obſerves, that in order to come to a certainty where this Ophir was, it will be neceſſary to examine what Scripture ſays of it, and to keep preciſely to every thing like deſcription which we can find there, without indulging our fancy farther. 1*ſt*, Then, the trade to Ophir was carried on from the Elanitic gulf through the Indian ocean. 2*dly*, The returns were gold, ſilver, and ivory, but eſpecially ſilver †. 3*dly*, The time of the going and coming of the fleet was preciſely three years ‡, at no period more or leſs.

2 Hypotheſis of Mr Bruce

Now, if Solomon's fleet ſailed from the Elanitic gulf to the Indian ocean, this voyage of neceſſity muſt have been made by monſoons, for no other winds reign in that ocean. And what certainly ſhows this was the caſe, is the preciſe term of three years in which the fleet went and came between Ophir and Ezion-gaber.

† 1 Kings x 22.

‡ 1 Kings, x. 22. 2 Chron. ix. 21.

Theſe mines of Ophir were probably what furniſhed the Eaſt with gold in the earlieſt times: great traces of excavation muſt therefore have appeared.

But John dos Santos ſays, that he landed at Sofala in the year 1586; that he ſailed up the great river Cuama as far as Tete, where, always deſirous to be in the neighbourhood of gold, his order had placed their convent. Thence he penetrated for about two hundred leagues into the country, and ſaw the gold mines then working at a mountain called *Aſura*. At a conſiderable diſtance from theſe are the ſilver mines of Chicoua; at both places there is a great appearance of ancient excavations; and at both places the houſes of the kings are built with mud and ſtraw, whilſt there are large remains of maſſy buildings of ſtone and lime.

3 Arguments in ſupport of it

Every thing then conſpires to fix the Ophir of Solomon in the kingdom of Sofala, provided it would neceſſarily require neither more nor leſs than three years to make a voyage from Ezion-gaber to that place and Tarſhiſh and return. To eſtabliſh this important fact, our author obſerves, that the fleet or ſhip for Sofala, parting in June from Ezion-gaber (ſee EZION-GABER), would run down before the northern monſoon to Mocha (ſee MOCHA). Here, not the monſoon, but the direction of the gulf, changes; and the violence of the ſouth-weſters, which then reign in the Indian ocean, make themſelves at times felt even in Mocha roads. The veſſel therefore comes to an anchor in the harbour of Mocha; and here ſhe waits for moderate weather and a fair wind, which carries her out of the ſtraits of Babelmandel, through the few leagues where the wind is variable.

Her courſe from this is nearly ſouth-weſt, and ſhe meets at Cape Guardafui, a ſtrong ſouth-weſter that blows directly in her teeth. Being obliged to return into the gulf, ſhe miſtakes this for a trade-wind; becauſe ſhe is not able to make her voyage to Mocha but by the ſummer monſoon, which carries her no farther than the ſtraits of Babelmandel, and then leaves her in the face of a contrary wind, a ſtrong current to the northward, and violent ſwell.

The attempting this voyage with ſails, in theſe circumſtances, was abſolutely impoſſible, as their veſſels went only before the wind: if it was performed at all, it muſt have been by oars; and great havock and loſs of men muſt have been the conſequence of the ſeveral trials.

At laſt, philoſophy and obſervation, together with the unwearied perſeverance of man bent upon his own views and intereſt, removed theſe difficulties, and ſhowed the mariners of the Arabian gulf, that theſe periodical winds, Ophir. winds, which in the beginning they looked upon as invincible barriers to the trading to Sofala, when once underſtood, were the very means of performing this voyage ſafely and expeditiouſly.

The veſſel trading to Sofala ſailed from the bottom of the Arabian gulf in ſummer, with the monſoon at north, which carried her to Mocha. There the monſoon failed her by the change of the direction of the gulf. The ſouth-weſt winds, which blow without Cape Guardafui in the Indian ocean, forced themſelves round the cape ſo as to be felt in the road of Mocha, and make it uneaſy riding there. But thoſe ſoon changed, the weather became moderate, and the veſſel, we ſuppoſe in the month of Auguſt, was ſafe at anchor under Cape Guardafui, where was the port which, many years afterwards, was called *Promontorium Aromatum.* Here the ſhip was obliged to ſtay all November, becauſe all theſe ſummer months the wind ſouth of the cape was a ſtrong ſouth-weſter, as hath been before ſaid, directly in the teeth of the voyage to Sofala. But this time was not loſt; part of the goods bought to be ready for the return was ivory, frankincenſe, and myrrh; and the ſhip was then at the principal mart for theſe.

Our author ſuppoſes, that in November the veſſel ſailed with the wind at north-eaſt, with which ſhe would ſoon have made her voyage: but off the coaſt of Melinda, in the beginning of December, ſhe there met an anomalous monſoon at ſouth-weſt, in our days firſt obſerved by Dr Halley, which cut off her voyage to Sofala, and obliged her to put into the ſmall harbour of Mocha, near Melinda, but nearer ſtill to Tarſhiſh, which we find here by accident, and which we think a ſtrong corroboration that we are right as to the reſt of the voyage. In the annals of Abyſſinia, it is ſaid that Amda Sion, making war upon that coaſt in the 14th century, in a liſt of the rebellious Mooriſh vaſſals, mentions the chief of Tarſhiſh as one of them, in the very ſituation where we have now placed him.

Solomon's veſſel, then, was obliged to ſtay at Tarſhiſh till the month of April of the ſecond year. In May, the wind ſet in at north-eaſt, and probably carried her that ſame month to Sofala. All the time ſhe ſpent at Tarſhiſh was not loſt, for part of her cargo was to be brought from that place; and ſhe probably bought, beſpoke, or left it there. From May of the ſecond year, to the end of that monſoon in October, the the veſſel could not ſtir; the wind was north-eaſt. But that time, far from being loſt, was neceſſary to the traders for getting in their cargo, which we ſhall ſuppoſe was ready for them.

The ſhip ſails on her return, in the month of November of the ſecond year, with the monſoon ſouth-weſt, which in a very few weeks would have carried her into the Arabian gulf. But off Mocha, near Melinda and Tarſhiſh, ſhe met the north-eaſt monſoon, and was obliged to go into that port and ſtay there till the end of that monſoon; after which a ſouth-weſter came to her relief in May of the third year. With the May monſoon ſhe ran to Mocha within the ſtraits, and was there confined by the ſummer monſoon blowing up the Arabian gulf from Suez, and meeting her. Here ſhe lay till that monſoon which in ſummer blows northerly from Suez, changed to a ſouth-eaſt one in October or November, and that very eaſily brought her up into the Elanitic gulf, the middle or end of December of the third year. She had no need of more time to complete her voyage, and it was not poſſible ſhe could do it in leſs. Ophir.

Such is a very ſhort and imperfect abſtract of our author's reaſons for placing Ophir in Sofala. If it excite the curioſity of our readers to conſult his work, it will anſwer the purpoſe for which we have made it.

We are now to give another ingenious conjecture concerning the ſituation of Ophir and Tarſhiſh, with which we have been favoured by Dr Doig, the learned author of Letters on the Savage State, addreſſed to Lord Kames. 4 Another hypotheſis.

This reſpectable writer holds that Ophir was ſomewhere on the weſt coaſt of Africa, and that Tarſhiſh was the ancient Bætica in Spain. His eſſay is not yet publiſhed: but he authoriſes us to give the following abſtract of it: "The firſt time that *Ophir*, or rather *Aufir*, occurs in Scripture, is in Gen, x. 29. where the ſacred hiſtorian, enumerating the ſons of Joktan, mentions Aufir as one of them." According to his account, the deſcendants of thoſe 13 brothers ſettled all in a contiguous ſituation, from Meſha (the Mocha of the moderns) to Sepharah, a mountain of the eaſt. Moſes, as every one knows, denominates countries, and the inhabitants of countries, from the patriarch from whom thoſe inhabitants deſcended. In deſcribing the courſe of one of the branches of the river of paradiſe, the ſame Moſes informs us that it encompaſſed the whole land of Havilah, &c. which abounded with fine gold, bdellium, and the onyx ſtone; and this land had its name from Havilah the 12th ſon of the patriarch Jotkan. *Ophir* or *Aufir* was Havilah's immediate elder brother; and of courſe the deſcendants of the former, in all probability, fixed their habitation in the neighbourhood of thoſe of the latter. If, then, the land of Havilah abounded with gold and precious ſtones, the land of Ophir undoubtedly produced the very ſame articles.

Here then we have the original Ophir; here was found the primary gold of Ophir; and here lay the Ophir mentioned in Job xi. 24. But as navigation was then in its infant ſtate, the native land of gold mentioned by Job muſt have been much nearer home than that to which the fleets of Solomon and Hiram made their triennial voyages. That ſeveral countries on the ſouth-eaſt coaſt of Africa abounded with gold long after the era of Job, is evident from the teſtimony of Herodotus, Strabo, Diodorus Siculus, Ptolemy, Pomponius Mela, &c.; but that in theſe countries the Ophir of Solomon could not be ſituated, is plain, becauſe his ſhips in the ſame voyage touched at Tarſhiſh, which lay in a very different quarter. 5 The original Ophir not the Ophir of Solomon; of which

The Abyſſinian traveller has placed this *regio aurifera* in Sofala on the eaſtern coaſt of Africa, nearly oppoſite to the iſland of Madagaſcar. This hypotheſis was current a hundred years before he was born; but I am perſuaded (ſays our author) that it is not tenable. The Ophir of Solomon, in whatever part of Africa it lay, muſt have been well known, prior to his reign, both to the Phœnicians and the Edomites. Theſe people navigated that monarch's fleet, and therefore could be no ſtrangers to the port whither they were bound. That it it was in Africa is certain; and that it was on the weſt coaſt of that immenſe peninſula, will appear more than probable, when we have aſcertained the ſituation of Tarſhiſh, and the uſual courſe of Phœnician navigation. To theſe objects, therefore, we ſhall now direct our inquiries.

6
The ſituation muſt be aſcertained by diſcovering that of Tarſhiſh.

" Javan, the fourth ſon of the patriarch Japhet, had four ſons, Eliſha, *Tarſhiſh*, Kittim, and Dodanim or Rodanim; among whoſe ' deſcendants were the iſles of the Gentiles divided.' The city of *Tarſus* on the coaſt of Cilicia, at once aſcertains the region colonized by the deſcendants of Tarſhiſh. But as much depends upon determining the poſition of this country, I ſhall endeavour (ſays the Doctor) to fix it with all poſſible preciſion.

" In the firſt place, I muſt beg leave to obſerve, that there is not a ſingle paſſage in any ancient author, ſacred or profane, that ſo much as alludes to any city, diſtrict, canton, or country, of the name of Tarſhiſh in the eaſtern parts of the world. The deſcendants of Javan, of whom Tarſhiſh was one, are agreed on all hands to have extended their ſettlements towards the north-weſt, i. e. into Aſia Minor, Italy, and Spain. The inhabitants of Tarſhiſh are everywhere in Scripture ſaid to be addicted to navigation and commerce, in which they ſeem to have been connected with the Tyrians and Phœnicians †, who were always ſaid by the Jews to inhabit the iſles of the ſea. Indeed, in Hebrew geography, all the countries toward the north and weſt, which were divided from Judea by the ſea, were called the iſles of the ſea ‡. Thus Iſaiah: ' The burden of Tyre. Howl ye ſhips of Tarſhiſh, for it is laid waſte, ſo that there is no houſe, no entering in: from the land of Chittim it is revealed unto them. Be ſtill ye inhabitants of the iſle, thou whom the merchants of Zidon, that paſs over the ſea, have repleniſhed.' The land of Chittim was Macedonia, and often Greece, from which every one knows that the deſtruction of Tyre came; and that Tarſhiſh was not an unconcerned ſpectator of that deſtruction, is obvious from the ſame prophet, who proceeds to ſay ‖: ' As at the report concerning Egypt, ſo ſhall they be ſorely pierced at the report concerning Tyre. Paſs over to Tarſhiſh; howl ye inhabitants of the iſle. Is this your joyous city?' It appears likewiſe from Ezekiel xxvii. 12. that Tarſhiſh was the merchant with whom Tyre traded for ſilver, iron, tin, and lead, and that this trade was carried on in fairs.

† Pſ. xlviii. 7. lxxii. 10.

‡ Gen. ii. 26.

‖ Iſ. xxiii. *paſſim*.

7
The original Tarſhiſh where ſituated.

" From all theſe paſſages, it ſeems to be evident, that the deſcendants of Tarſhiſh ſettled on the weſtern coaſt of Aſia Minor; that theſe people were addicted to navigation and commerce; that in the courſe of their traffic they were connected with the Tyrians and Phœnicians; that the commerce they carried on conſiſted of ſilver, iron, tin, and lead; that the people of Tarſhiſh were connected with Kittim and the iſles of the Gentiles, which are confeſſedly ſituated toward the north and weſt of Judea.

" But leſt, after all, a fact ſo fully authenticated ſhould ſtill be called in queſtion, I ſhall add one proof more, which will place the matter beyond the reach of doubt and controverſy.

" When the prophet Jonah intended to flee from the preſence of the Lord, in order to avoid preaching at Nineveh, let us ſee where the peeviſh deſerter embarked. (Jonah i. 3.) " And Jonah roſe up to flee unto Tarſhiſh, from the preſence of the Lord, and went down to Joppa; and he found a ſhip going to Tarſhiſh, and he paid the fare thereof, and went down into it, to go with them into Tarſhiſh, from the preſence of the Lord.' Every body knows that Joppa or Japhah ſtood upon the ſhore of the Mediterranean; of courſe the fugitive prophet had determined to go to ſome very diſtant region weſtward, and by that means to get as far from Nineveh as poſſible."

8
This not the Tarſhiſh of Solomon.

Having thus proved to a demonſtration, that the original Tarſhiſh was a region on the weſtern coaſt of Aſia Minor, where either the patriarch of that name, or ſome of his immediate deſcendants, planted a colony, it remains to determine whether this was actually the country from which Solomon imported the vaſt quantities of ſilver mentioned by the ſacred hiſtorian. That it was not, our author frankly acknowledges; and therefore, ſays he, we muſt look out for Solomon's Tarſhiſh in ſome other quarter of the globe.

9
The name of one country transferred to another.

To pave the way for this diſcovery, he very juſtly obſerves, that it has at all times been a common practice to transfer the name of one country to another, in conſequence of ſome analogy or reſemblance between them. It has likewiſe often happened, that when a commodity was brought from a very diſtant country by a very diſtant people, the people to whom it was imported have taken it for granted that it was produced in the region from which it was immediately brought to them. Of the truth of this poſition no man acquainted with the Greek and Roman poets can for a moment entertain a doubt. Hence the *Aſſyrium amomum* of Virgil, and the *Aſſyrium malabathrum* of Horace, though theſe articles were the product not of Aſſyria but of India. The Jews, who were as little acquainted with foreign countries as the Greeks and Romans, had very probably the ſame notions with them reſpecting articles of commerce; and if ſo, they would undoubtedly ſuppoſe, that the ſilver ſold by the merchants of Tarſhiſh was the product of that country. When this miſtake came to be diſcovered, they very naturally transferred the name *Tarſhiſh* from the country of the merchants to that of the articles which they imported. Let us now, ſays our author, try if we cannot find out where that country was.

It has been already ſhown, by quotations from Iſaiah and Ezekiel, that the merchants of Tarſhiſh traded in the markets of Tyre with ſilver, iron, lead, and tin. To theſe authorities, we ſhall add another from Jeremiah: " Silver (ſays that prophet) ſpread into plates is brought from Tarſhiſh." " But in Spain (continues our learned diſſertator), all thoſe commodities were found in the greateſt abundance. All the ancient authors who deſcribe that region dwell with rapture on its ſilver mines. This fact is too generally known to need to be ſupported by authorities. Spain was then the region which furniſhed Solomon's traders with the immenſe maſs of ſilver he is ſaid to have imported. This was, one might ſay, the modern Tarſhiſh; and indeed both Joſephus and Euſebius are poſitive that the poſterity of Tarſhiſh actually peopled that country. If this was an early opinion, as it certainly was, the Jews would of courſe denominate Spain from the patriarch in queſtion.

I have ſhown above, that the inhabitants of Tarſhiſh

ſhiſh were ſtrictly connected with the Kittim, or Grecians: I ſhall here produce an authority which will prove to a demonſtration that the Kittim had extended their commerce into that part of Africa now called Barbary.

" The prophet Ezekiel, (xxvii. 6.) deſcribing the ſplendour and magnificence of Tyre, tells us, 'that the company of the Aſhurites made her benches of ivory, brought from the iſles of Kittim.' In the firſt place, I muſt obſerve, that there is probably a ſmall error in the orthography of the word Aſhurim. This term is everywhere in Scripture tranſlated Aſſyrians, which tranſlation is certainly juſt. But how the Aſſyrians could export ivory from the iſles of Kittim, and faſhion it into benches for the Tyrian mariners, is, in my opinion, a problem of no eaſy ſolution. The fact is Aſhurim ſhould be Aſherim, that is, the company of the men of Aſher. The tribe of Aſher obtained its inheritance in the neighbourhood of Tyre; (ſee Joſh. xix. 28.) 'And Hebron, and Rehob, and Hammon and Canah, unto Zidon the great.' The companies of the tribe of the Aſherites then, and not the Aſhurim, were the people who manufactured the benches in queſtion.

" Be that as it may, the ivory of which the implements were formed was imported from the iſles of Kittim, that is, from Greece and its neighbourhood. Theſe iſlands, it is certain, never produced ivory. They muſt therefore have imported it from ſome other country; but no other country, to which the Greeks and their neighbours could have extended their commerce, except the north of Africa, produced that commodity. The concluſion then is, that the maritime ſtates of Aſia Minor, Greece, and probably the Hetruſcans on the weſt coaſt of Italy, carried on a gainful commerce with Spain and Barbary at a very early period.

" We have now ſeen that the original Tarſhiſh on the coaſt of Aſia Minor did not produce the metals imported by Solomon's fleet; that no Tarſhiſh is to be found in the eaſtern parts of the globe; that the Tarſhiſh we are in queſt of was undoubtedly ſituated ſomewhere towards the weſt of Judea: we have ſhown that the mercantile people of Aſia Minor, Greece, and probably of Italy, actually imported ſome of thoſe articles from the coaſt of Africa; we have hazarded a conjecture, that Spain was the modern Tarſhiſh, and that very country from which Solomon imported his ſilver, and the Tyrians their ſilver, iron, tin, and lead. Let us now make a trial whether we cannot exhibit ſome internal proofs in ſupport of the hypotheſis we have above adopted.

" The ancients divided Spain into three parts, Bætica, Luſitania, and Tarraconenſis. Bætica is the modern Andaluſia. It ſtretched along the Fretum Herculeum, or Straits of Gibraltar, to the mouth of the Gualdalquiver. This region is thought by ſome to have been the Elyſian Fields of the poets. The river Bætis, which divides it, is called *Tarteſſus* by Ariſtotle, Steſichorus, Strabo, Pauſanias, Steph. Byzant. and Avianus. Here too we have a city and a lake of the ſame name. But Tarteſſus is poſitively the very ſame with Tarſhiſh. The Phœnicians, by changing *ſchin* into *thau*, made it Tartiſh. The Greeks manufactured the reſt, by changing Tartiſh into Tartis, and in proceſs of time into ταρτησσος. That the Phœnicians actually changed *ſchin* into *thau* is certain; for Plutarch tells us, in the life of Sylla, that in their language an ox was called *thor*, which is, no doubt, the ſame with the Hebrew *ſhor*.

10 Tarſhiſh Spaniſh Bætica.

" From this deduction, it appears highly probable at leaſt, that the Spaniſh Bætica was originally called *Tarſhiſh*. Indeed this ſimilarity of names has operated ſo powerfully on the learned Bochart, and on ſome other moderns of no mean figure, that they have poſitively affirmed, as Joſephus had done before them, that the patriarch Tarſhiſh actually ſettled in that country. This I ſhould think not altogether probable; but that his deſcendants who ſettled on the coaſt of Aſia Minor colonized Bætica, and carried on an uninterrupted commerce to that country, along with the Phœnicians, for many centuries after it was peopled, and that from the circumſtances above narrated, it was denominated *Tarſhiſh*, are facts too palpable to admit of contradiction.

" Let us now ſee whether this Bætica, where I have endeavoured to fix the ſituation of the Tarſhiſh of the Scriptures, was actually furniſhed with thoſe articles of commerce which are ſaid to have been imported from that country. To enlarge on this topic would be altogether ſuperfluous. Diodorus Siculus, Strabo, Polybius, Pliny, Solinus, and, in one word, all the Greek and Roman hiſtorians who have mentioned that region, have unanimouſly exhibited it as the native land of ſilver, iron, and tin: to theſe, contrary to the opinions of the celebrated modern traveller, they likewiſe add gold in very large quantities."

Our author having thus aſcertained the ſituation of Tarſhiſh, proceeds to prove, by a maſs of evidence too large for our inſertion, that the Edomites and Tyrians had doubled the Cape, and almoſt encompaſſed Africa, long before the era of Solomon. Then referring to 1 Kings, chap. ix. and x. 2 Chron, viii. ix. 2 Kings xxii. and 2 Chron. xx. he obſerves, that from theſe authorities it appears indubitable, that the fleets of Solomon and Hiram ſailed from Eloth and Eziongeber; that the voyages to Ophir and Tarſhiſh were exactly the ſame, performed at one and the ſame time, by the very ſame fleet; which muſt neceſſarily have encompaſſed the peninſula of Africa before it could arrive at the country of Tarſhiſh. This being the caſe, the traders might eaſily enough collect the gold on the coaſt of Guinea, or on what is now vulgarly called the *Gold Coaſt*. The ivory they might readily enough procure on the Barbary coaſt, oppoſite to Tarſhiſh. In Africa, too, they might hunt apes, monkeys, baboons, &c.; and peacocks, or rather parrots, and parroquets, they might ſurpriſe in the foreſts which abounded on the coaſt. In Spain, ſilver, iron, lead, and tin, were, one may ſay, the native produce of the ſoil. Even at this early period, the Phœnician navigators had diſcovered the Caſſiterides or Scilly iſlands, and Cornwall; and from that region, in company with the merchants, may have ſupplied them with that rare commodity.

" I have ſuppoſed that the navy of Solomon and Hiram collected their gold in the courſe of their voyage ſomewhere on the coaſt of Africa, beyond the Cape, for the following reaſons: Had they found the golden fleece

Ophir.

fleece at Sofala (A), or any part of the coaſt of Africa, they would have choſen to return and unlade at Eloth or Ezion-geber, rather than purſue a long and dangerous courſe, quite round Africa, to Tarſhiſh; to which laſt country they might have ſhaped their courſe much more commonly from Zidon, Tyre, Joppa, &c. But being obliged to double the Cape in queſt of ſome of theſe articles which they were enjoined to import, they puſhed onward to Tarſhiſh, and returned by the Pillars of Hercules to Tyre, or perhaps to Joppa, &c. Their next voyage commenced from one or other of theſe ports, from which they directed their courſe to Tarſhiſh; and having taken in part of their lading there, they afterwards coaſted round Africa, and ſo arrived once more at Eloth or Ezion-geber.

"Let us now attend to the ſpace of time in which theſe voyages were performed. We are told expreſsly (2 Chron. ix. 21.) that once every three years came the ſhips of Tarſhiſh, &c. This is exactly the time one would naturally imagine neceſſary to perform ſuch a diſtant voyage, at a period when navigation was ſtill in its infancy, and mariners ſeldom adventured to loſe ſight of the coaſt. Of this we have an irrefragable proof in the hiſtory of a voyage round the very ſame continent, undertaken and accompliſhed in the very ſame ſpace of time, about two centuries after.

"We learn from Herodotus, lib. ii. cap. 149. that Nechus, one of the latter kings of Egypt, whom the Scripture calls *Pharaoh Necho*, built a great number of ſhips, both on the Red ſea and the Mediterranean. The ſame hiſtorian, lib. iv. cap. 42. informs us, that this enterpriſing monarch projected a voyage round the continent of Africa, which was actually accompliſhed in the ſpace of three years. In the conduct of this enterpriſe, he employed Phœnician mariners, as Solomon had done before him. Theſe, we may ſuppoſe, were aſſiſted in the courſe of this navigation by charts or journals, or at leaſt by traditional accounts derived from their anceſtors: 'Theſe navigators (ſays the hiſtorian) took their departure from a port on the Red ſea, and ſailing from thence into the ſouthern ocean, and, in the beginning of autumn, landing on the coaſt of Africa, there they ſowed ſome grain which they had carried out with them on board their veſſels. In this place they waited till the crop was ripened; and, having cut it down, they proceeded on their voyage. Having ſpent two years in this navigation, in the third they returned to Egypt, by the Pillars of Hercules. Theſe mariners, adds the author, reported a fact, which, for his part, he could by no means believe to be true; namely, that in one part of their courſe their ſhadows fell on their right; a circumſtance which gives conſiderable weight to the truth of the relation.'

"Let it now be obſerved, that Phœnician mariners navigated the fleet of Solomon: the ſame people conducted that of Necho: the fleet of Necho ſpent three years in the courſe of its voyage; that of Solomon did the ſame in its courſe about two centuries before: the fleet of Necho ſailed from a port on the Red ſea; that of Solomon took its departure from Eloth or Ezion-geber, ſituated on the ſame ſea: the fleet of the former returned by the Pillars of Hercules; that of the latter, according to the hypotheſis, purſued the very ſame route. Such a coincidence of ſimilar circumſtances united with thoſe adduced in the preceding part of this article, ſeem to prove almoſt to a demonſtration, that the navy of Hiram and Solomon performed a voyage round Africa, in that age, in the ſame manner as that of Necho did two centuries after.

"Upon the whole, I conclude, that the original Ophir, which is really Aufir or Aufr, was ſituated on the ſouth of Arabia Felix, between Sheba and Havilah, which laſt was encompaſſed by one of the branches of the river of Paradiſe: that the name Ophir, i. e. Aufr, was, in conſequence of its reſemblance, in proceſs of time transferred to a region on the coaſt of Africa; and that from it firſt *Afer* and then Africa was denominated: that the primitive Tarſhiſh was Cilicia, and that the Jews applied this name to all the commercial ſtates on the coaſt of Aſia Minor, and perhaps of Italy, there being ſtrong preſumptions that the Tyrrhenians were coloniſts from Tarſhiſh; that Bætica, and perhaps ſome other regions of Spain, being planted with colonies from Tarſhiſh, likewiſe acquired the name of Tarſhiſh; that the Tyrians were ſtrictly connected with the merchants of Tarſhiſh in their commercial enterpriſes; that Tarſhiſh was certainly ſituated weſtward from Judea, Phœnicia, &c.; that no other country in the weſtern quarters produced the commodities imported by the two kings, except Spain and the oppoſite coaſts; that this country, in thoſe ages, produced not only ſilver, iron, tin, and lead, but likewiſe gold in great abundance; that the merchants of Kittim imported ivory, of which the Aſherites made benches for the Tyrians; which commodity they muſt have purchaſed on the coaſt of Barbary, where the Jews and Phœnicians would find the ſame article; that Tarſhiſh being ſituated in Spain, it was impoſſible for a fleet ſailing from Eloth or Ezion-geber, to arrive at that country without encompaſſing Africa; that, of courſe, the fleet in queſtion did actually encompaſs that continent; that the Ophir of Solomon muſt have been ſituated ſomewhere on the coaſt of Africa, to the weſt of the Cape, becauſe from it the courſe to Tarſhiſh was more eligible than to return the ſame way back to Ezion-geber."

11 Ophir ſituated on the coaſt of Africa, weſt of the Cape.

Our author ſupports this concluſion by many other arguments and authorities, which the limits preſcribed us will not permit us to detail; but perhaps the article might be deemed incomplete if we did not ſhow how he obviates an objection that will readily occur to his theory. "If the original Ophir was ſeated on the coaſt of Arabia Felix, and the modern region of the ſame name on the weſt coaſt of Africa, it may be made a queſtion, how the latter country came to be denominated from the former? Nothing (ſays our author) can be more eaſy than to anſwer this queſtion. The practice of adapting the name of an ancient country to

12 An objection anſwered.

(A) That Sofala oppoſite to the iſland of Madagaſcar was Ophir, was an ancient conjecture. See Bochart, chan. l. ii. cap. 27. p. 160. 4to.

to a newly discovered one, resembling the other in appearance, in situation, in figure, in distance, in the nature of the climate, productions, &c. has ever been so common, that to produce instances would be altogether superfluous. The newly discovered region on the coast of Africa abounded with the same species of commodities by which the original one was distinguished; and of course, the name of the latter was annexed to the former."

Whether Mr Bruce's hypothesis, or Dr Doig's, respecting the long-disputed situation of Solomon's *Ophir*, be the true one, it is not for us to decide. Both are plausible, both are supported by much ingenuity and uncommon erudition; but we do not think that the arguments of either writer furnish a complete confutation of those adduced by the other. *Sub judice lis est.*

OPHIRA, a genus of plants belonging to the octandria class. See BOTANY *Index*.

OPHITES, in *Natural History*, an old term employed to denote a mineral, of a dusky green ground, sprinkled with spots of a lighter green, otherwise called *serpentine*. See MINERALOGY *Index*.

OPHITES, in church history, Christian heretics, so called both from the veneration they had for the serpent that tempted Eve, and the worship they paid to a real serpent: they pretended that the serpent was Jesus Christ, and that he taught men the knowledge of good and evil. They distinguished between *Jesus* and *Christ*: Jesus, they said, was born of the Virgin, but Christ came down from heaven to be united with him; Jesus was crucified, but Christ had left him to return to heaven. They distinguished the God of the Jews, whom they termed *Jaldabaoth*, from the supreme God: to the former they ascribed the body, to the latter the soul of man. They had a live serpent, which they kept in a kind of cage; at certain times they opened the cage door, and called the serpent: the animal came out, and mounting upon the table, twined itself about some loaves of bread; this bread they broke and distributed it to the company, who all kissed the serpent: this they called their *Eucharist*.

OPHRYS, TWYBLADE; a genus of plants belonging to the gynandria class; and in the natural method ranking under the 7th order, *Orchideæ*. See BOTANY *Index*.

OPHTHALMOSCOPY, a branch of physiognomy, which deduces the knowledge of a man's temper and character from the appearance of his eyes.

OPHTHALMIA, in *Medicine*, an inflammation of the eye or of the membranes which invest it; especially of the adnata, or albugineous coat. See MEDICINE, N° 174.

OPIATES, medicines which are administered to procure sleep, whether in the form of electuaries, drops, or pills.

OPINION is that judgement which the mind forms of any proposition for the truth or falsehood of which there is not sufficient evidence to produce science or absolute belief.

That the three angles of a plane triangle are equal to two right angles, is not a matter of *opinion*, nor can it with propriety be called an object of the mathematician's *belief*: he does more than believe it; he *knows* it to be true. When two or three men, under no temptation to deceive, declare that they were witnesses of an uncommon, though not preternatural event, their testimony is complete evidence, and produces absolute *belief* in the minds of those to whom it is given; but it does not produce *science* like rigid demonstration. The fact is not doubted, but those who have it on report do not *know* it to be true, as they know the truth of propositions intuitively or demonstrably certain. When one or two men relate a story including many circumstances to a third person, and another comes who positively contradicts it either in whole or in part, he to whom those jarring testimonies are given, weighs all the circumstances in his own mind, balances the one against the other, and lends an assent, more or less wavering, to that side on which the evidence appears to preponderate. This assent is his *opinion* respecting the facts of which he has received such different accounts.

Opinions are often formed of events not yet in being. Were an officer from the combined armies, which are just now † besieging Valenciennes, to come into the room where we are writing, and tell us that those armies are in good health and high spirits; that every shot which they fire upon the fortress produces some effect; and that they have plenty of excellent provisions, whilst the besieged are perishing by hunger; we should absolutely *believe* every fact which he had told us upon the evidence of his testimony; but we could only be of *opinion* that the garrison must soon surrender. In forming opinions of this kind, upon which, in a great measure depends our success in any pursuit, every circumstance should be carefully attended to, and our judgements guided by former experience. Truth is a thing of such importance to man, that he should always pursue the best methods for attaining it; and when the object eludes all his researches, he should remedy the disappointment, by attaching himself to that which has the strongest resemblance to it; and that which most resembles truth is called *probability*, as the judgement which is formed of it is termed *opinion*. See PROBABILITY.

† July 1793.

OPIUM, in the *Materia Medica*, is an inspissated juice, obtained from the capsule of the white poppy, partly of the resinous and partly of the gummy kind, and possessing also a narcotic principle. See MATERIA MEDICA, N° 612.

OPOBALSAMUM, in the *Materia Medica*, Opobalsam, or balm of Gilead, a resinous substance obtained from a species of AMYRIS. See CHEMISTRY, N° 2472, and MATERIA MEDICA, N° 507.

OPOCALPASUM, OPOCARBASUM, or APOCALPASUM; a gummy resinous substance, which has a strong resemblance to liquid myrrh, and which in the time of Galen was mixed with myrrh. It was difficult, according to this writer, to distinguish the one from the other unless by their effects, the former being of a poisonous nature, which frequently produced lethargy.

OPOPONAX, in the *Materia Medica*, is a gummy resinous substance brought from the East Indies. See MATERIA MEDICA, N° 455.

OPORTO, or PORTO, a flourishing city and seaport of Portugal, in the province of Entre-Douero-e-Minho, with a bishop's see. Nature has rendered it almost impregnable; and it is justly celebrated for the strength of its wines, large quantities of which are exported

Oporto || Opoun.

ported to Britain, and on this account all red wines either from Spain or Portugal are denominated *port wines*. After the earthquake at Lisbon in the year 1755, the trade of this city increased rapidly, before which memorable period its population did not exceed 20,000; but it is now computed at upwards of 40,000. Oporto is situated on the declivity of a mountain, near the river Douero, which forms an excellent and commodious harbour; and is about 147 miles north by east of Lisbon. W. Long. 8. 21. N. Lat. 41. 10.

OPOSSUM, in *Zoology*, a species of didelphis. See DIDELPHIS.

OPOUN, one of the Navigators Islands, of which there are ten in number, first discovered by Bougainville, and so called by him, because the inhabitants do not pass from one village to another but in canoes. This and the other islands lie in 14° south latitude, and from 171° to 173° longitude west from Paris, according to Perouse. Here the sugar cane is to be met with growing spontaneously; but it is said to contain less of the saccharine substance than what is produced in the West Indies. The men are possessed of uncommon strength, and tatow their bodies in such a manner that, although almost naked, they have the appearance at a little distance of being clothed. Ferocity and treachery are characteristic marks of this people, of which the unfortunate Perouse had but too soon a melancholy proof, 11 out of 60 of his crew having been murdered by them, although received at first with an air of good humour. This ought to serve as a caution to future navigators, not to place implicit confidence in the apparent kindness of these savages, which is frequently the dismal prelude of ruin and destruction. Among these fell the celebrated naturalist Lamanon; see LAMANON.

Oppenheim || Optic.

OPPENHEIM, a town of Germany, in the lower palatinate of the Rhine, and capital of a bailiwick of the same name; seated on the declivity of a hill near the Rhine. E. Long. 8. 20. N. Lat. 49. 48.

OPPIANUS, a poet and grammarian of Anazarba in Cilicia, in the second century. He composed a poem of hunting, and another of fishing, for which Antoninus Caracalla gave him as many golden crowns as there were verses in his poems; they were hence called *Oppian's golden verses*. He died in the 30th year of his age.

OPPILATION, in *Medicine*, the act of obstructing or stopping up the passage of the body, by redundant or peccant humours. This word is chiefly for obstructions in the lower belly.

OPTATIVE MOOD, in *Grammar*, that which serves to express an ardent desire or wish for something.

In most languages, except the Greek, the optative is only expressed by prefixing to the subjunctive an adverb of wishing: as *utinam*, in Latin; *plut à Dieu*, in French; and *would to God*, in English.

OPTIC ANGLE, the angle which the optic axes of both eyes make with one another, as they tend to meet at some distance before the eyes.

OPTIC Axis, the axis of the eye, or a line going through the middle of the pupil and the centre of the eye.

OPTICS.

History.

1 Definition.

OPTICS, from ὀπτομαι, *to see*, is that science which considers the nature, the composition, and the motion of light;—the changes which it suffers from the action of bodies;—the phenomena of vision, and the instruments in which light is the chief agent.

HISTORY.

SECT. I. *Discoveries concerning the Refraction of Light.*

2 Refraction known to the ancients;

THOUGH the ancients made few optical experiments, they nevertheless knew, that when light passed through media of different densities, it did not move in a straight line, but was bent or *refracted* out of its original direction. This was probably suggested to them by the appearance of a straight rod partly immersed in water; and accordingly we find many questions concerning this and other optical appearances in the works of Aristotle. Archimedes is said to have written a treatise on the appearance of a ring or circle under water, and therefore could not have been ignorant of the common phenomena of refraction. The ancients, however, were not only acquainted with these more ordinary appearances, but also with the production of colours by refraction. Seneca says, that if the light of the sun shines through an angular piece of glass, it will show all the colours of the rainbow. These colours, he says, are false, such as are seen in a pigeon's neck when it changes its position; and of the same nature, he says, is a speculum, which, without having any colour of its own, assumes that of any other body. It appears also, that the ancients were not ignorant of the magnifying power of glass globes filled with water, though they do not seem to have been acquainted with its cause; and the ancient engravers are supposed to have used a glass globe filled with water to magnify their figures. This indeed seems evident, from their lenticular and spherical gems of rock crystal which are still preserved, the effect of which, in magnifying at least, could scarcely have escaped the notice of those who had often occasion to handle them; if indeed, in the spherical or lenticular form, they were not solely intended for the purposes of burning. One of these, of the spherical kind, of about an inch and a half diameter, is preserved among the fossils presented by Dr Woodward to the university of Cambridge.

3 and the magnifying power of glass globes.

4 Refraction first treated scientifically by Ptolemy.

The first treatise of any consequence written on the subject of optics, was by the celebrated Ptolemy. The treatise is now lost; but from the accounts of others, we find that he treated of astronomical refractions. The first astronomers were not aware that the intervals between stars appear less near the horizon than near the meridian; but it is evident that Ptolemy was aware of this circumstance, by the caution which he gives to allow something

History. ſomething for it, upon every recourſe to ancient obſervations.

5 His hypotheſis concerning the horizontal ſun and moon.

Ptolemy alſo advances a very ſenſible hypotheſis to account for the greater apparent ſize of the ſun and moon when ſeen near the horizon. The mind, he ſays, judges of the ſize of objects by means of a preconceived idea of their diſtance from us: and this diſtance is fancied to be greater when a number of objects intervene; which is the caſe when we ſee the heavenly bodies near the horizon. In his Almageſt, however, he aſcribes this appearance to a refraction of the rays by vapours, which actually enlarge the angle ſubtended by the luminaries.

6 Diſcoveries of Alhazen.

The nature of refraction was afterwards conſidered by Alhazen an Arabian writer; inſomuch that, having made experiments upon it at the common ſurface between air and water, air and glaſs, water and glaſs; and, being prepoſſeſſed with the ancient opinion of cryſtalline orbs in the regions above the atmoſphere, he even ſuſpected a refraction there alſo, and fancied he could prove it by aſtronomical obſervations. Hence this author concludes, that refraction increaſes the altitudes of all objects in the heavens; and he firſt advanced, that the ſtars are ſometimes ſeen above the horizon by means of refraction, when they are really below it. This obſervation was confirmed by Vitellio, B. Waltherus, and by the excellent obſervations of Tycho Brahe. Alhazen obſerved, that refraction contracts the vertical diameters and diſtances of the heavenly bodies, and that it is the cauſe of the twinkling of the ſtars. But we do not find that either he, or his follower Vitellio, ſubjected it to menſuration. Indeed it is too ſmall to be determined except by very accurate inſtruments, and therefore we hear little more of it till about the year 1500; when great attention was paid to the ſubject by Bernard Walther, Mæſtlin, and Tycho Brahe.

Alhazen ſuppoſed that the refraction of the atmoſphere did not depend upon the vapours, but on the different tranſparency; by which, as Montucla conjectures, he meant the denſity of the groſs air contiguous to the earth, and the ether or ſubtile air that lies beyond it. We judge of diſtance, he ſays, by comparing the angle under which objects appear, with their ſuppoſed diſtance; ſo that if theſe angles be nearly equal, and the diſtance of one object be conceived greater than that of the other, it will be imagined to be larger. He alſo obſerves, that the ſky near the horizon is always imagined to be further from us than any other part of the concave ſurface. Roger Bacon aſcribes this account of the horizontal moon to Ptolemy; and as ſuch it is examined, and objected to by B. Porta.

In the writings of Roger Bacon, we find the firſt diſtinct account of the magnifying power of glaſſes; and it is not improbable, that what he wrote upon this ſubject gave riſe to the uſeful invention of ſpectacles. He ſays, that if an object be applied cloſe to the baſe of the larger ſegment of a ſphere of glaſs, it will appear magnified. He alſo treats of the appearance of an object through a globe, and ſays that he was the firſt who obſerved the refraction of rays into it.

7 Of Vitellio. 1270.

Vitellio, a native of Poland, publiſhed a treatiſe of optics, containing all that was valuable in Alhazen. He obſerves, that light is always loſt by refraction; but he does not pretend to eſtimate the quantity of this loſs. He reduced into a table the reſult of his experiments on the refractive powers of air, water, and glaſs, correſponding to different angles of incidence. In his account of the horizontal moon he agrees exactly with Alhazen. He aſcribes the twinkling of the ſtars to the motion of the air in which the light is refracted; and to illuſtrate this hypotheſis, he obſerves, that they twinkle ſtill more when viewed in water put in motion. He alſo ſhows, that refraction is neceſſary as well as reflection, to form the rainbow; becauſe the body which the rays fall upon is a tranſparent ſubſtance, at the ſurface of which one part of the light is always reflected and another refracted. But he ſeems to conſider refraction as ſerving only to condenſe the light, thereby enabling it to make a ſtronger impreſſion upon the eye. This writer alſo makes many attempts to aſcertain the law of refraction. He likewiſe conſiders the foci of glaſs ſpheres, and the apparent ſize of objects ſeen through them: though upon theſe ſubjects his obſervations are inaccurate. It is ſufficient indeed to ſhow the ſtate of knowledge, at that time, to obſerve, that both Vitellio, and his maſter Alhazen, account for objects appearing larger when ſeen under water, by the circular figure of its ſurface; ſince, being fluid, it conforms to the figure of the earth.

8 Of Roger Bacon.

Contemporary with Vitellio was Roger Bacon, a man of extenſive genius, who wrote upon almoſt every branch of ſcience; yet in optics he does not ſeem to have made any conſiderable advances. Even ſome of the moſt abſurd of the opinions of the ancients have had the ſanction of his authority. He believed that viſual rays proceed from the eye; becauſe every thing in nature is qualified to diſcharge its proper functions by its own powers, in the ſame manner as the ſun and other celeſtial bodies. In his *Specula Mathematica*, he added ſome obſervations of little importance on the refraction of the light of the ſtars; the apparent ſize of objects; the enlargement of the ſun and moon in the horizon. In his *Opus Majus* he demonſtrates, what Alhazen had done before, that if a tranſparent body interpoſed between the eye and an object, be convex towards the eye, the object will appear magnified.

9 Of Maurolycus. 1575.

From this time, to that of the revival of learning in Europe, we have no treatiſe on optics. One of the firſt who diſtinguiſhed himſelf in this way was Maurolycus, teacher of mathematics at Meſſina. In two works, entitled *Theoremata Lucis et Umbræ*, and *Diaphanorum Partes*, &c. he demonſtrates that the cryſtalline humour of the eye is a lens that collects the rays of light iſſuing from the object, and throws them upon the retina, where is the focus of each pencil. From this principle he diſcovered the reaſon why ſome people were ſhort-ſighted and others long-ſighted; and why the former are relieved by concave, and the others by convex, glaſſes.

10 Diſcoveries of B. Porta. Born 1445. Died 1515.

While Maurolycus made ſuch advances towards the diſcovery of the nature of viſion, Baptiſta Porta of Naples invented the *camera obſcura*, which throws ſtill more light on the ſame ſubject. His houſe was reſorted to by all the ingenious perſons at Naples, whom he formed into *an academy of ſecrets;* each member being obliged to contribute ſomething uſeful and not generally known. By this means he was furniſhed with materials for his *Magia Naturalis*, which contains his account of the *camera obſcura*, and which was publiſhed, as he informs us, when he was not quite 15 years old. He alſo gave

History. gave the first hint of the magic lantern; which Kircher afterwards improved. His experiments with the *camera obscura* convinced him, that vision, as Aristotle supposed, is performed by the intromission of something into the eye, and not by visual rays proceeding from the eye, as had been formerly imagined by Empedocles; and he was the first who fully satisfied himself and others upon this subject. The resemblance indeed between experiments with the *camera obscura* and the manner in which vision is performed in the eye, was too striking to escape the observation of a less ingenious person. But when he says that the eye is a *camera obscura*, and the pupil the hole in the window shutter, he was so far mistaken as to suppose that it was the crystalline humour that corresponds to the wall which receives the images; nor was it discovered till the year 1604, that this office is performed by the retina. He makes a variety of just observations on vision; and explains several cases in which we imagine things to be without the eye, when the appearances are occasioned by some affection of the organ itself, or some motion within it. He remarks also, that, in certain circumstances, vision will be assisted by convex or concave glasses; and he seems also to have made some small advances towards the discovery of telescopes. He observes, that a round and flat surface plunged into water, will appear hollow as well as magnified to an eye above it; and he explains by a figure the manner in which this effect is produced.

11
The law of refraction discovered. 1637.

The great problem concerning the measure of refractions was still unsolved. Alhazen and Vitellio, indeed, had attempted it; but failed, by trying to measure the angle instead of its sine. At last it was discovered by Snellius, professor of mathematics at Leyden. This philosopher, however, did not perfectly understand his own discovery, nor did he live to publish any account of it. It was afterwards explained by Professor Hortensius before it appeared in the writings of Descartes, who published it under a different form, without making any acknowledgement of his obligations to Snellius, whose papers Huygens assures us, were seen by Descartes. Before this time Kepler had published a New Table of Angles of Refraction, determined by his own experiments, for every degree of incidence. Kircher had done the same, and attempted a theory of refraction, on principles, which, if conducted with precision, would have led him to the law discovered by Snellius.

12
Opinions of Descartes and Leibnitz on this subject.

Descartes undertook to explain the cause of refraction by the resolution of forces. Hence he was obliged to suppose that light passes with more ease through a dense medium, than through a rare one. The truth of this explanation was first questioned by M. Fermat, who asserted, contrary to the opinion of Descartes, that light suffers more resistance in water than air, and more in glass than in water; and maintained, that the resistance of different media with respect to light is in proportion to their densities. M. Leibnitz adopted the same general idea, upon the principle that nature accomplishes her ends by the shortest methods, and that light therefore ought to pass from one point to another, either by the shortest road, or that in which the least time is required.

At a meeting of the Royal Society, Aug. 31. 1664, it was found, with a new instrument prepared for that purpose, that the angle of incidence being 40 degrees, that of refraction is 30. About this time also we find the first mention of media not refracting the light in an exact proportion to their densities. For Mr Boyle, in a letter to Mr Oldenburgh, dated Nov. 3. 1664, observes, that in spirit of wine, the proportion of the sines of the angles of incidence to the sines of the angles of refraction was nearly the same as 4 to 3; and that, as spirit of wine occasions a greater refraction than common water, so oil of turpentine, which is lighter than spirit of wine, produces not only a greater refraction than common water, but a much greater than salt water. And at a meeting held November 9. the same year, Dr Hooke mentioned, that pure and clear salad oil produced a much greater refraction than any liquor which he had tried; the angle of refraction that answered to an angle of incidence of 30° being no less than 40° 30′, and the angle of refraction that answered to an angle of incidence of 20° being 29° 47′.—M. de la Hire also made several experiments to ascertain the refractive power of oil, and found the sine of the angle of incidence to that of refraction as 60 to 42; which, he observes, is a little nearer to that of glass than to that of water, though oil is much lighter than water, and glass much heavier.

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13
Discoveries concerning the refraction of different substances.

The members of the Royal Society finding that the refraction of salt water exceeded that of fresh, pursued the experiment farther with aqueous solutions of vitriol, saltpetre, and alum. They found the refraction of the solution of vitriol and saltpetre a little more, but that of alum a little less, than common water.

Dr Hooke made an experiment before the Royal Society, Feb. 11. 1663, which clearly proves that ice refracts the light less than water. M. de la Hire also took a good deal of pains to determine whether the refractive power of ice and water were the same; and he found as Dr Hooke had done before, that ice refracts less than water.

By a most accurate experiment made in 1698, in which a ray of light was transmitted through a Torricellian vacuum, Mr Lowthorp found, that the refractive power of air is to that of water as 36 to 34.400. He observes, that the refractive power of bodies is not proportioned to the density, at least not to the specific gravity, of the refracting medium. For the refractive power of glass to that of water is as 55 to 34, whereas its specific gravity is as 87 to 34; that is, the squares of their refractive powers are very nearly as their respective gravities. And there are some fluids, which, though they are lighter than water, yet have a greater power of refraction. Thus the refractive power of spirit of wine, according to Dr Hooke's experiment, is to that of water as 36 to 33, and its gravity reciprocally as 33 to 36, or $36\frac{1}{2}$. But the refractive powers of air and water seem to observe the simple direct proportion of their gravities.

The Royal Academy of Sciences at Paris endeavoured to repeat this experiment in 1700; but they did not succeed.—For, as they said, beams of light passed through the vacuum without suffering any refraction. The Royal Society being informed of this, ordered Mr Hawksbee to make an instrument for the purpose, under the direction of Dr Halley, for the purpose of repeating the experiment. It consisted of a strong brass prism, two sides of which had sockets to receive two plane glasses, History

glasses, whereby the air in the prism might either be exhausted or condensed. The prism had also a mercurial gage fixed to it, to discover the density of the contained air; and turned upon its axis, in order to make the refractions equal on each side when it was fixed to the end of a telescope. The refracting angle was near 64°; and the length of the telescope, having a fine hair in its focus, was about 10 feet. The event of this accurate experiment was as follows:—Having chosen a proper object, whose distance was 2588 feet, June 15. O. S. 1708, in the morning, the barometer being then at 29.7½, and the thermometer at 60, they first exhausted the prism, and then applying it to the telescope, the horizontal hair in the focus covered a mark on the object distinctly seen through the vacuum, the two glasses being equally inclined to the visual ray. Then admitting the air into the prism, the object was seen to rise above the hair gradually as the air entered, and when the prism was full, the hair was observed to hide a mark 10¼ inches below the former mark.

After this they applied the condensing engine to the prism; and having forced in another atmosphere, so that the density of the included air was double to that of the outward, they again placed it before the telescope, and, letting out the air, the object which before seemed to rise, appeared gradually to descend, and the hair at length rested on an object higher than before by the same interval of 10¼ inches. They then forced in another atmosphere; and upon discharging the condensed air, the object was seen near 21 inches lower than before.

Now the radius in this case being 2588 feet, 10¼ inches will subtend an angle of 1′ 8″, and the angle of incidence of the visual ray being 32 degrees (because the angle of the glass planes was 64°), it follows from the known laws of refraction, that as the sine of 39° is to that of 31° 59′ 26″, differing from 32° by 34″ the half of 1′ 8″; so is the sine of any other angle of incidence, to the sine of its angle of refraction; and so is radius, or 1000000, to 999736; which, therefore, is the proportion between the sine of incidence *in vacuo* and the sine of refraction from thence into common air.

14 Refractive power of the air determined.

It appears, by these experiments, that the refractive power of the air is proportional to its density. And since the density of the atmosphere is as its weight directly, and its temperature inversely, the ratio of its density, at any given time, may be had by comparing the heights of the barometer and thermometer; and thence he concludes that this will also be the ratio of the refraction of the air. But Dr Smith observes, that, before we can depend upon the accuracy of this conclusion, we ought to examine whether heat and cold alone may not alter the refractive power of air, while its density continues the same.

The French academicians, being informed of the result of the above-mentioned experiment, employed M. De l'Isle the younger to repeat the former experiment with more care: He presently found, that their operators had never made any vacuum at all, there being chinks in their instrument, through which the air had insinuated itself. He therefore annexed a gage to his instrument, by which means he was sure of his vacuum; and then the result of the experiment was the same with that of the Royal Society. The refraction was always proportional to the density of the air, excepting when the mercury was very low, and consequently the air very rare; in which case the whole quantity being very small, he could not perceive much difference in them. Comparing, however, the refractive power of the atmosphere, observed at Paris, with the result of his experiment, he found, that the best vacuum he could make was far short of that of the regions above the atmosphere.

Dr Hooke first suggested the idea of making allowance for the effect of the refraction of light, in passing from the rarer to the denser regions of the atmosphere, in the computed height of mountains. To this he ascribes the different opinions of authors concerning the height of several very high hills. He could not account for the appearance of very high mountains, at so great a distance as that at which they are actually seen, but upon the supposition of the curvature of the visual ray, that is made by its passing obliquely through a medium of such different density, from the top of them to the eye, very far distant in the horizon. All calculations of the height of mountains that are made upon the supposition that the rays of light come from the tops of them, to our eyes, in straight lines, he considers very erroneous.

Dr Hooke ascribes the twinkling of the stars to the irregular and unequal refraction of the rays of light, which is also the reason why the limbs of the sun, moon, and planets, appear to wave or dance. That there is such an unequal distribution of the atmosphere, he says, will be evident by looking upon distant objects, over a piece of hot glass, which cannot be supposed to throw out any kind of exhalation from itself, as well as through ascending steams of water.

15 Colours discovered to arise from refraction.

About this time Grimaldi first observed that the coloured image of the sun refracted through a prism is always oblong, and that colours proceed from refraction. —The way in which he first discovered this was by Vitellio's experiment already mentioned, in which a piece of white paper placed at the bottom of a glass vessel filled with water, and exposed to the light of the sun, appears coloured. However, he observed, that in case the two surfaces of the refracted medium were exactly parallel to each other, no colours were produced. But of the true cause of those colours, he had not the least suspicion. This discovery was reserved for Sir Isaac Newton.

16 Different refrangibility of the rays of light discovered by Sir Isaac Newton. 1666.

Having procured a triangular glass prism to satisfy himself concerning the phenomena of colours; he was surprised at the oblong figure of the coloured spectrum, and the great disproportion betwixt its length and breadth; the former being about five times the measure of the latter. After various conjectures respecting the causes of these appearances, he suspected that the colours might arise from the light being dilated by some unevenness in the glass, or some other accidental irregularity; and to try this, he took another prism like the former, and placed it in such a manner, that the light, passing through them both, might be refracted in opposite directions, and thus be returned by the latter into the same course from which it had been diverted by the former. In this manner he thought that the regular effects of the first prism would be augmented by the multiplicity of refractions. The event was, that the light, diffused by the first prism into an oblong form, was by

History. by the fecond reduced into a circular one, with as much regularity as if it had not paffed through either of them. He then hit upon what he calls the *experimentum crucis*, and found that light is not fimilar, or homogeneous; but that it confifts of rays, fome of which are more refrangible than others: fo that, without any difference in their incidence on the fame medium, fome of them fhall be more refracted than others; and therefore, that, according to their particular degrees of refrangibility, they will be tranfmitted through the prifm to different parts of the oppofite wall.

Since it appears from thefe experiments that different rays of light have different degrees of refrangibility, it follows, that the rules laid down by preceding philofophers concerning the refractive power of water, glafs, &c. muft be limited to the mean rays of the fpectrum. Sir Ifaac, however, proves, both geometrically and by experiment, that the fine of the incidence of every kind of light, confidered apart, is to its fine of refraction in a given ratio.

17 Mr Dollond's difcovery of the method of correcting the error of refracting telefcopes.

The moft important difcovery concerning refraction fince the time of Sir Ifaac Newton is that of Mr Dollond, who found out a method of remedying the defects of refracting telefcopes arifing from the different refrangibility of light. Sir Ifaac Newton imagined that the different rays were refracted in the fame proportion by every medium, fo that the refrangibility of the extreme rays might be determined if that of the mean ones were given. From this it followed, as Mr Dollond obferves, that equal and contrary refractions muft not only deftroy each other, but that the divergency of the colours from one refraction would likewife be corrected by the other, and that there could be no poffibility of producing any fuch thing as refraction without colour. Hence it was natural to infer, that all object glaffes of telefcopes muft be equally affected by the different refrangibility of light, in proportion to their apertures, of whatever materials they may be formed.

For this reafon, philofophers defpaired of bringing refracting telefcopes to perfection. They therefore applied themfelves chiefly to the improvement of the reflecting telefcope; till 1747, when M. Euler, improving upon a hint of Sir Ifaac Newton's, propofed to make object glaffes of water and glafs; hoping, that by their difference of refractive powers, the refractions would balance one another, and thereby prevent the difperfion of the rays that is occafioned by their difference of refrangibility. This memoir of M. Euler excited the attention of Mr Dollond. He went over all M. Euler's calculations, fubftituting for his hypothetical laws of refraction thofe which had been afcertained by Newton; and found, that, it followed from Euler's own principles, that there could be no union of the foci of all kinds of colours, but in a lens infinitely large.

Euler did not mean to controvert the experiments of Newton: but afferted, that, if they were admitted in all their extent, it would be impoffible to correct the difference of refrangibility occafioned by the tranfmiffion of the rays from one medium into another of different denfity; a correction which he thought was very poffible, fince he fuppofed it to be effected in the eye, which he confidered as an achromatic inftrument. To this reafoning Mr Dollond made no reply, but by appealing to the experiments of Newton, and the circumfpection with which it was known that he conducted all his inquiries.

This paper of Euler's was particularly noticed by M. Klingenftierna of Sweden, who found that, from Newton's own principles, the refult of his 8th experiment could not anfwer his defcription of it. Newton found, that when light paffes out of air through feveral media, and thence goes out again into air, whether the refracting furfaces be parallel or inclined to one another, this light, as often as by contrary refractions it is fo corrected as to emerge in lines parallel to thofe in which it was incident, continues ever after to be white; but if the emergent rays be inclined to the incident, the whitenefs of the emerging light will, by degrees, become tinged at its edges with colours. This he tried by refracting light with prifms of glafs, placed within a prifmatic veffel of water.

By theorems deduced from this experiment he infers, that the refractions of the rays of *every* fort, made out of any medium into air, are known by having the refraction of the rays of *any one* fort; and alfo that the refraction out of one medium into another is found as often as we have the refractions out of them both into any third medium.

On the contrary, the Swedifh philofopher obferves, that, in this experiment, the rays of light, after paffing through the water and the glafs, though they come out parallel to the incident rays, will be coloured; but that the fmaller the glafs prifm is, the nearer will the refult of it approach to Newton's defcription.

This paper of M. Klingenftierna being communicated to Dollond, made him entertain doubts concerning Newton's report, and induced him to have recourfe to experiment.

He therefore cemented together two plates of glafs at their edges, fo as to form a prifmatic veffel, when ftopped at the ends; and the edge being turned downwards, he placed in it a glafs prifm, with one of its edges upwards, and filled up the vacancy with clear water; fo that the refraction of the prifm was contrary to that of the water, in order that a ray of light, tranfmitted through both thefe refracting media, might be affected by the difference only between the two refractions. As he found the water to refract more or lefs than the glafs prifm, he diminifhed or increafed the angle between the glafs plates, till he found the two contrary refractions to be equal; which he difcovered by viewing an object through this double prifm. For when it appeared neither raifed or depreffed, he was fatisfied that the refractions were equal, and that the emergent and incident rays were parallel.

But according to the prevailing opinion, the object fhould have appeared of its natural colour; for if the difference of refrangibility had been equal in the two equal refractions, they would have rectified each other. This experiment, therefore, fully proved the fallacy of the received opinion, by fhowing the divergency of the light by the glafs prifm to be almoft double of that by the water; for the image of the object was as much infected with the prifmatic colours, as if it had been feen through a glafs wedge only, whofe refracting angle was near 30 degrees.

Mr Dollond was convinced that if the refracting angle of the water veffel could have admitted of a fufficient increafe, the divergency of the coloured rays would have been greatly diminifhed, or entirely rectified; and that there would have been a very great refraction without

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out colour; but the inconvenience of so large an angle as that of the prismatic vessel must have been, to bring the light to an equal divergency with that of the glass prism whose angle was about 60 degrees, made it necessary to try some experiments of the same kind with smaller angles.

He, therefore, got a wedge of plate glass, the angle of which was only nine degrees; and using it in the same circumstances, he increased the angle of the water wedge, in which it was placed, till the divergency of the light by the water was equal to that by the glass; that is, till the image of the object, though considerably refracted by the excess of the refraction of the water, appeared quite free from any colours proceeding from the different refrangibility of the light; and as near as he could then measure, the refraction by the water was about $\frac{3}{4}$ of that by the glass.

As these experiments proved, that different substances caused the light to diverge very differently in proportion to their general refractive power, Mr Dollond began to suspect that such a variety might possibly be found in different kinds of glass.

His next object, therefore, was to grind wedges of different kinds of glass, and apply them together; so that the refractions might be made in contrary directions, in order to discover whether the refraction and the divergency of the colours would vanish together.

From these experiments, which were not made till 1757, he discovered a difference far beyond his hopes in the refractive qualities of different kinds of glass, with respect to the divergency of colours. The yellow or straw-coloured kind, commonly called *Venice glass*, and the *English crown glass*, proved to be nearly alike in that respect; though, in general, the crown glass seemed to make light diverge less than the other. The common English plate glass made the light diverge more; and the white crystal, or English flint glass, most of all.

He then examined the particular qualities of every kind of glass that he could obtain, to fix upon two kinds in which the difference of their dispersive powers should be the greatest; and he soon found these to be the crown glass and the white flint glass. He therefore ground one wedge of white flint, of about 25 degrees; and another of crown glass, of about 29 degrees; which refracted very nearly alike, but their power of making the colours diverge was very different. He then ground several others of crown glass to different angles, till he got one which was equal, with respect to the divergency of the light, to that in the white flint glass; for when they were put together, so as to refract in contrary directions, the refracted light was entirely free from colours. Then measuring the refraction of each wedge with these different angles, he found that of the white glass to be to that of the crown glass nearly as two to three: so that any two wedges made in this proportion, and applied together, that they might refract in a contrary direction, would transmit the light without any dispersion of the rays. He found also, that the sine of incidence in crown glass is to that of its general refraction as 1 to 1.53, and in flint glass as 1 to 1.583.

In order to apply these discoveries to the construction of telescopes, Mr Dollond considered, that, in order to make two spherical glasses that should refract the light in contrary directions, the one must be concave and the other convex; and as the rays are to converge to a real focus, the excess of refraction must be in the convex lens. Also, as the convex glass is to refract the most, it appeared from his experiments, that it must be made of crown glass, and the concave of white flint glass. Farther, As the refractions of spherical glasses are in the inverse ratio of their focal distances, it follows, that the focal distances of the two glasses shall be inversely as the ratios of the refractions of the wedges; for being thus proportioned, every ray of light that passes through this combined glass, at whatever distance it may pass from its axis, will constantly be refracted, by the difference between two contrary refractions, in the proportion required; and therefore the different refrangibility of the light will be entirely removed.

The difficulties which occurred in the application of this reasoning to practice, arose from the following circumstances. In the first place, The focal distances, as well as the particular surfaces, must be very nicely proportioned to the densities or refracting powers of the glasses, which are very apt to vary in the same sort of glass made at different times. Secondly, The centres of the two glasses must be placed truly in the common axis of the telescope, otherwise the desired effect will be in a great measure destroyed. And thirdly, The difficulty of forming the four surfaces of the lenses exactly spherical. At length, however, after numerous trials, he was able to construct refracting telescopes, with such apertures and magnifying powers, under limited lengths, as far exceeded any thing that had been produced before, representing objects with great distinctness, and in their natural colours.

As Mr Dollond did not explain the method by which he determined the curvatures of his lenses, the celebrated M. Clairaut, who had begun to investigate this subject, endeavoured to reduce it to a complete theory, from which rules might be deduced, for the benefit of the practical optician.

With this view, therefore, he endeavoured to ascertain the refractive power of different kinds of glass, and also their property of dispersing the rays of light. For this purpose he made use of two prisms, as Mr Dollond had done: but, instead of looking through them, he placed them in a dark room; and when the transmitted image of the sun was perfectly white, he concluded that the different refrangibility of the rays was corrected.

In order to ascertain more easily the true angles that prisms ought to have in order to destroy the effect of the difference of refrangibility, he constructed a prism which had one of its surfaces cylindrical, with several degrees of amplitude. By this means, without changing his prisms, he had the choice of an infinity of angles; among which, by examining the point of the curve surface, which, receiving the solar ray, gave a white image, he could easily find the true one. He also ascertained the proportion in which different kinds of glass separated the rays of light, by measuring, with proper precautions, the oblong image of the sun made by transmitting through them a beam of light.

In these experiments M. Clairaut was assisted by M. de Tournieres, and the results agreed with Mr Dollond's in general; but whereas Mr Dollond had made the dispersion of the rays in glass and in water to be as five

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five to four (acknowledging, however, that he did not pretend to do it with exactneſs), theſe gentlemen, who took more pains, found it to be as three to two. For the theorems and problems deduced by M. Clairaut from theſe new principles of optics, with a view to the perfection of teleſcopes, we muſt refer the reader to *Mem. Acad. Par.* 1756, 1757.

The ſubject of achromatic teleſcopes was alſo inveſtigated by the illuſtrious D'Alembert. This excellent mathematician propoſed a variety of new conſtructions, the advantages and diſadvantages of which he diſtinctly notes; at the ſame time that he points out ſeveral methods of correcting the errors to which theſe teleſcopes are liable: as by placing the object glaſſes, in ſome caſes, at a ſmall diſtance from one another, and ſometimes by uſing eye glaſſes of different refractive powers; which is an expedient that does not ſeem to have occurred to any perſon before him. He even ſhows, that teleſcopes may be made to advantage, conſiſting of only one object glaſs, and an eye glaſs of a different refractive power. Some of his conſtructions have two or more eye glaſſes of different kinds of glaſs. This ſubject he conſidered at large in one of the volumes of his *Opuſcules Mathematiques.* We have alſo three memoirs of M. D'Alembert upon this ſubject, among thoſe of the French Academy; in the years 1764, 1765, and 1767.

The inveſtigations of Clairaut and D'Alembert do not ſeem to have aſſiſted the exertions of foreign artiſts. The teleſcopes made in England, according to no exact rule, as foreigners ſuppoſed, were greatly ſuperior to any that could be made elſewhere, though under the immediate direction of thoſe able calculators.

M. Euler, who firſt gave occaſion to this inquiry, having perſuaded himſelf, both by reaſoning and calculation, that Mr Dollond had diſcovered no new principle in optics, and yet not being able to controvert Mr Short's teſtimony in favour of the achromatic teleſcopes, concluded that this extraordinary effect was partly owing to the crown glaſs not tranſmitting all the red light, which would otherwiſe have come to a different focus, and have diſtorted the image; but principally to his giving a juſt curvature to his glaſs, which he did not doubt would have produced the ſame effect if the lenſes had all been made of the ſame kind of glaſs. At another time he imagined that the goodneſs of Mr Dollond's teleſcopes might be owing to the eye glaſs. If my theory, ſays he, be true, this diſagreeable conſequence follows, that Mr Dollond's object glaſſes cannot be exempt from the diſperſion of colours: yet a regard to ſo reſpectable a teſtimony embarraſſes me extremely, it being as difficult to queſtion ſuch expreſs authority, as to abandon a theory which appears to me well founded, and to embrace an opinion which is as contrary to all the eſtabliſhed laws of nature as it is ſtrange and ſeemingly abſurd. He even appeals to experiments made in a darkened room; in which he ſays, he is confident that Mr Dollond's object-glaſſes would appear to have the ſame defects to which others are ſubject.

Not doubting, however, but that Mr Dollond had made ſome improvement in the conſtruction of teleſcopes, by the combination of glaſſes, he abandoned his former project, in which he had recourſe to different media, and confined his attention to the correction of the errors which ariſe from the curvature of lenſes. But while he was proceeding, as he imagined, upon the true principles of optics, he could not help expreſſing his ſurpriſe that Mr Dollond ſhould have been led to ſo important a diſcovery by reaſoning in a manner quite contrary to the nature of things. At length, however, M. Euler was convinced of the reality and importance of Mr Dollond's diſcoveries; and frankly acknowledges, that perhaps he ſhould never have been brought to aſſent to it, had he not been aſſured by his friend M. Clairaut that the experiments of the Engliſh optician might be depended upon. The experiments of M. Zeiher, however, gave him the moſt complete ſatisfaction with reſpect to this ſubject. This gentleman demonſtrated, that it is the lead in the compoſition of glaſs which produces the variation in its diſperſive power; and, by increaſing the quantity of lead in the mixture, he produced a kind of glaſs, which occaſioned a much greater ſeparation of the extreme rays than the flint glaſs which Mr Dollond had made uſe of.

From theſe new principles M. Euler deduces theorems concerning the combination of the lenſes, and, in a manner ſimilar to M. Clairaut and D'Alembert, points out methods of conſtructing achromatic teleſcopes.

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Different compoſitions of glaſs for the purpoſe of correcting the imperfection of teleſcopes.

While he was employed upon this ſubject, he informs us, that he received a letter from M. Zeiher, dated Peterſburgh 30th of January 1764, in which he gives him a particular account of the ſucceſs of his experiments on the compoſition of glaſs; and that, having mixed minium and ſand in different proportions, the reſult of the mean refraction and the diſperſion of the rays varied according to the following table.

	Proportion of minium to flint.	Ratio of the mean refraction from air into glaſs.	Diſperſion of the rays in compariſon of crown glaſs.
I.	— 3 : 1	2028 : 1000	4800 : 1000
II.	— 2 : 1	1830 : 1000	3550 : 1000
III.	— 1 : 1	1787 : 1000	3259 : 1000
IV.	— $\frac{3}{4}$: 1	1732 : 1000	2207 : 1000
V.	— $\frac{1}{2}$: 1	1724 : 1000	1800 : 1000
VI.	— $\frac{1}{4}$: 1	1664 : 1000	1354 : 1000

From this table it is evident, that a greater quantity of lead not only produces a greater diſperſion of the rays, but alſo increaſes the mean refraction. The firſt of theſe kinds of glaſs, which contains three times as much minium as flint, will appear very extraordinary; ſince, hitherto, no tranſparent ſubſtance has been known, whoſe refractive power exceeded the ratio of two to one, and ſince the diſperſion occaſioned by this glaſs is almoſt five times as great as that of crown glaſs, which could ſcarcely be believed by thoſe who entertained any doubt concerning the ſame property in flint glaſs, the effect of which is three times as great as crown glaſs.

Here, however, M. Euler announces to us another diſcovery of M. Zeiher, no leſs ſurpriſing than the former, and which diſconcerted all his ſchemes for reconciling the above-mentioned phenomena. As the ſix kinds of glaſs mentioned in the preceding table were compoſed of nothing but minium and flint, M. Zeiher happened to think of mixing alkaline ſalts with them, in order to give the glaſs a conſiſtence more proper for dioptric uſes: This mixture, however, greatly diminiſhed

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ed the mean refraction, almost without making any change in the dispersion. After many trials, he is said to have obtained a kind of glass, which occasioned three times as great a dispersion of the rays as the common glass, at the same time that the mean refraction was only as 1.61 to 1.; though we have not heard that this kind of glass was ever used in the construction of telescopes.

Mr Dollond was not the only optician who had the merit of discovering the achromatic telescope, as this instrument appears to have been constructed by a private gentleman—Mr Chester More Hall. He observed that prisms of flint glass gave larger spectra than prisms of water, when the mean refraction was the same in both. He tried prisms of other glass, and found similar differences; and he applied this discovery to the same purposes as Mr Dollond. These facts came out in a process raised at the instance of Watkins optician, as also in a publication of Mr Ramsden. There is, however, no evidence that Dollond stole the idea from Mr Hall, or that they had not both claims to the discovery.

The best refracting telescopes, constructed on the principles of Mr Dollond, are still defective, on account of that colour which, by the aberration of the rays, they give to objects viewed through them, unless the object glass be of small diameter. This defect philosophers have endeavoured to remove by various contrivances, and Boscovich has, in his attempts for this purpose, displayed much ingenuity; but the philosopher whose exertions have been crowned with most success, and who has perhaps made the most important discovery in this science, is Dr Robert Blair professor of practical astronomy in the college of Edinburgh. By a judicious set of experiments, he has proved, that the quality of dispersing the rays in a greater degree than crown glass, is not confined to a few media, but is possessed by a great variety of fluids, and by some of these in a most extraordinary degree. He has shown, that though the greater refrangibility of the violet rays than of the red rays, when light passes from any medium whatever into a vacuum, may be considered as a law of nature; yet in the passage of light from one medium into another, it depends entirely on the qualities of the media which of these rays shall be the most refrangible, or whether there shall be any difference in their refrangibility. In order to correct the aberration arising from difference of refrangibility among the rays of light, he instituted a set of experiments, by which he detected a very singular and important quality in the muriatic acid. In all the dispersive media hitherto examined, the green rays, which are the mean refrangible in crown glass, were found among the less refrangible; but in the muriatic acid, these same rays were found to make a part of the more refrangible. This discovery led to complete success in removing the great defect of optical instruments, viz. that dissipation or aberration of the rays which arises from their unequal refrangibility, and has hitherto rendered it impossible to converge all of them to one point either by single or opposite refractions. A fluid, in which the particles of marine acid and metalline particles hold a due proportion, at the same time that it separates the extreme rays of the spectrum much more than crown glass, refracts all the orders of the rays in the same proportion that glass does: and hence rays of all colours made to diverge by the refraction of the

19 Discovery of Dr Robert Blair for this purpose.

glass, may either be rendered parallel by a subsequent refraction in the confine of the glass and this fluid; or, by weakening the refractive density of the fluid, the refraction which takes place in the confine of it and glass may be rendered as regular as reflection, without the least colour whatever. The doctor has a telescope, not exceeding 15 inches in length, with a compound object glass of this kind, which equals in all respects, if it does not surpass, the best of Dollond's 42 inches long. See Phil. Trans. Edin. vol. iii.

20 Of the refraction of the atmosphere.

We shall conclude the history of the discoveries concerning refraction, with some account of the refraction of the atmosphere.—Tables of refraction have been calculated by Mr Lambert, with a view to correct inaccuracies in determining the altitudes of mountains geometrically. The observations of Mr Lambert go upon the supposition that the refractive power of the atmosphere is invariable: But as this is by no means the case, his rules must be considered as true only for the mean state of the air.

Dr Nettleton observed a remarkable variety in the refractive power of the atmosphere, which demonstrates how little we can depend upon the calculated heights of mountains, when the observations are made with an instrument, and when the refractive power of the air is to be taken into the account. Being desirous to learn, by observation, how far the mercury would descend in the barometer at any given elevation, he proposed to measure the height of some of their highest hills; but when he attempted it, he found his observation so much disturbed by refraction, that he could obtain no certain result. Having measured one hill of a considerable height, in a clear day, and observed the mercury at the bottom and at the top, he found, that about 19 feet or more were required to make the mercury fall $\frac{1}{10}$th of an inch; but afterwards, repeating the experiment, when the air was rather gross and hazy, he found the small angles so much increased by refraction as to make the hill much higher than before. He afterwards frequently made observations at his own house, by pointing a quadrant to the tops of some neighbouring hills, and observed that they would appear higher in the morning before sunrise, and also late in the evening, than at noon in a clear day, by several minutes. In one case the elevations of the same hill differed more than 30 minutes.

M. Euler considered the refractive power of the atmosphere, as affected by different degrees of heat and elasticity; in which he shows, that its refractive power, to a considerable distance from the zenith, is sufficiently near the proportion of the tangent of that distance, and that the law of refraction follows the direct ratio of the difference marked by the thermometer; but when stars are in the horizon, the changes are in a ratio somewhat greater than this, more especially on account of the variation in the heat.

21 La Place resolves the problem of astronomical refraction.

As the density of the atmosphere varies with its altitude, and as the irregular curvature of the earth causes a constant change in the inclination of the strata through which any ray of light passes to the eye, the refraction cannot be obtained from the density of the atmosphere, and the angular direction of the refracted ray. By comparing astronomical with meteorological observations, however, the celebrated M. La Place has given

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22 Phenomena of irregular refractions.

given a complete solution of this very important problem.

The phenomena known by the names of *mirage*, *looming*, and *fata morgana*, have been traced to irregularities of refractions arising from accidental changes in the temperature of the atmosphere. From the rarefaction of the air near the surface of water, buildings, or the earth itself, a distant object seen through this rarefied air sometimes appears depressed instead of raised by refraction; at other times it appears both elevated and depressed, so that the object seems double, and sometimes triple, one of the images being in an inverted position. This subject is much indebted to the researches of the ingenious Dr Wollaston, who has imitated these natural phenomena by viewing objects through the rarefied air contiguous to a red-hot poker, or through a saline or saccharine solution with water and spirit of wine floating upon its surface. This branch of optics has also been well illustrated by Mr Vince and Mr Huddart.

Sect. II. *Discoveries concerning the Reflection of Light.*

23 Discoveries of the ancients.

The followers of Plato were acquainted with the equality between the angles of incidence and reflection; and it is probable that they discovered this, by observing a ray of the sun reflected from standing water, or some other polished body; or from attending to the images of objects reflected by such surfaces. If philosophers paid any attention to this phenomenon, they could not but perceive, that, if the ray fell nearly perpendicular upon such a surface, it was reflected near the perpendicular; and if it fell obliquely, it was reflected obliquely: and observations upon these angles, the most rude and imperfect, could not fail to convince them of their equality, and that the incident and reflected rays were in the same plane.

Aristotle was sensible that it is the reflection of light from the atmosphere which prevents total darkness after the sun sets, and in places where he does not shine in the day time. He was also of opinion, that rainbows, halos, and mock suns, were occasioned by the reflection of the sunbeams in different circumstances, by which an imperfect image of his body was produced, the colour only being exhibited, and not his proper figure. The image, he says, is not single, as in a mirror; for each drop of rain is too small to reflect a visible image, but the conjunction of all the images is visible.

24 Treatise of optics by Euclid.

Without inquiring any farther into the nature of light or vision, the ancient geometers contented themselves with deducing a system of optics from two facts, the rectilineal progress of light, and the equality of the angles of incidence and reflection. The treatise of optics ascribed to Euclid is employed in determining the apparent size and figure of objects, from the angle which they subtend at the eye, and the apparent place of the image of an object reflected from a polished miror. This place he fixes at the point where the reflected ray meets a perpendicular to the mirror drawn through the object. But this work is so imperfect and inaccurate, that it does not seem to be the production of Euclid.

25 Burning glasses of the ancients.

It appears from Pliny and Lactantius, that burning glasses were known to the ancients. In one of the plays of Aristophanes, indeed, a person is introduced who proposes to destroy his adversary's papers by means of this instrument; and there is reason to believe that the Romans had a method of lighting their sacred fire by means of a concave speculum. It seems indeed to have been known A. C. 433, that there is an increase of heat in the place where the rays of light meet, after reflection from a concave mirror. The burning power of concave mirrors is noticed by the author of the work ascribed to Euclid. If we give any credit to what some ancient historians are said to have written concerning the exploits of Archimedes, we shall be induced to think that he constructed some very powerful burning mirrors: but nothing being said of other persons making use of his inventions, the whole account is very doubtful. It is allowed, however, that this eminent geometer did write a treatise on the subject of burning mirrors, which has not descended to our times.

B. Porta supposes that the burning mirrors of the ancients were parabolic and made of metal. It follows from the properties of this curve, that all the rays which fall upon it, parallel to its axis, will meet in the same point at the focus. Consequently, if the vertex of the parabola be cut off, as in fig. 1. it will make a convenient burning mirror. In some drawings of this instrument the frustum is so small, as to look like a ring. With an instrument of this kind, it is thought, that the Romans lighted their sacred fire, and that with a similar mirror Archimedes burnt the Roman fleet; using a lens, to throw the rays parallel, when they had been brought to a focus; or applying a smaller parabolic mirror for this purpose, as is represented fig. 2. Plate CCCLXXV Fig. 1. Fig. 2.

26 Of seeing images in the air.

The nature of reflection was, however, very far from being understood. Even Lord Bacon, who made much greater advances in physics than his predecessors, supposed it possible to see the image reflected from a looking glass, without seeing the glass itself; and to this purpose he quotes a story of Friar Bacon, who is reported to have apparently walked in the air between two steeples, and which was thought to have been effected by reflection from glasses while he walked upon the ground.

Vitellio had endeavoured to show that it is possible, by means of a cylindrical convex speculum, to see the images of objects in the air, out of the speculum, when the objects themselves cannot be seen. But from his description of the apparatus, it will be seen that the eye was to be directed towards the speculum placed within a room, while the object and the spectator were without it. But as no such effect can be produced by a convex mirror, Vitellio must have been under some deception with respect to his experiment.

B. Porta says, that this effect may be produced by a plain mirror only; and also by the combination of a plain and a concave mirror.

Kircher also speaks of the possibility of exhibiting these pendulous images, and supposes that they are reflected from the dense air: But the most perfect and pleasing deception, depending upon the images in the air, is one of which this writer gives a particular account in his *Ars Magna Lucis et Umbræ*, p. 783. In this case the image is placed at the bottom of a hollow polished cylinder, by which means it appears like a real solid substance, suspended within the mouth of the vessel.

27 Discoveries of Kepler.

It was Kepler who first discovered, that the apparent places of objects seen by reflecting mirrors depended upon

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28 Discoveries of Mr Boyle.

Mr Boyle made some curious observations concerning the reflecting powers of differently coloured substances. In order to shew that snow shines by a *borrowed* and not by a *native* light, he placed a quantity of it in a room, from which all foreign light was excluded, and found that it was completely invisible. To try whether white bodies reflect more light than others, he held a sheet of white paper in a sunbeam admitted into a darkened room; and observed that it reflected much more light than a paper of any other colour, a considerable part of the room being enlightened by it. To show that white bodies reflect the rays outwards, he adds, that common burning glasses require a long time to burn or discolour white paper; that the image of the sun was not so well defined upon white paper as upon black; that when he put ink upon the paper, the moisture would be quickly dried up, and the paper, which he could not burn before, would presently take fire;—and that by exposing his hand to the sun, with a thin black glove upon it, it would be suddenly and more considerably heated, than if he held his naked hand to the rays, or put on a glove of thin white leather.

To prove that black is the reverse of white, with respect to its property of reflecting the rays of the sun, he procured a large piece of black marble, ground into the form of a large concave speculum, and found that the image of the sun reflected from it was far from offending or dazzling his eyes, as it would have done from another speculum; and though this was large, he could not for a long time set a piece of wood on fire with it; though a far less speculum, of the same form, and of a more reflecting substance, would presently have made it flame.

To satisfy himself still farther with respect to this subject, he took a tile; and having made one half of its surface white and the other black, he exposed it to the summer sun. Having let it lie there some time, he found, that while the whitened part remained cool, the black part was very hot. He sometimes left part of the tile of its native red; and, after exposing the whole to the sun, observed that this part grew hotter than the white, but not so hot as the black part.

29 Of the infusion of lignum nephriticum.

A remarkable property of lignum nephriticum (a species of guilandina) was first observed by Kircher. Mr Boyle has described this lignum nephriticum as a whitish kind of wood, which was brought from Mexico, and which had been thought to tinge water of a green colour only; but he says that he found it to communicate all kinds of colours. If an infusion of this wood be put into a glass globe, and exposed to a strong light, it will be as colourless as pure water; but if it be carried into a place a little shaded, it will be a beautiful green. In a place still more shaded, it will incline to red; and in a very shady place, or in an opaque vessel, it will be green again.

Mr Boyle first distinctly noted the two very different colours which this remarkable tincture exhibits by transmitted and reflected light. If it be held directly between the light and the eye, it will appear tinged (excepting the very top of it, where a sky-coloured circle sometimes appears) almost of a golden colour, except the infusion be too strong; in which case it will be dark or reddish, and requires to be diluted with water. But if it be held from the light, so that the eye be between the light and the phial, it will appear of a deep lively blue colour; as will also the drops, if any lie on the outside of the glass.

When a little of this tincture was poured upon a sheet of white paper, and placed in a window where the sun shone upon it, he observed, that if he turned his back upon the sun, the shadow of any body projected upon the liquor would not be all dark, like other shadows; but that part of it would be curiously coloured, the edge of it next the body being almost of a lively golden colour, and the more remote part blue.

Observing that this tincture, if it were too deep, was not tinged in so beautiful a manner, and that the impregnating virtue of the wood did, by frequent infusion in fresh water, gradually decay, he conjectured that the tincture contained much of the essential salt of the wood; and to try whether the subtle parts, on which the colour depended, were volatile enough to be distilled, without dissolving their texture, he applied some of it to the gentle heat of a lamp furnace; but he found all that came over was as limpid and colourless as rock water, while that which remained behind was of so deep a blue, that it was only in a very strong light that it appeared of any colour.

Having sometimes brought a round long-necked phial, filled with this tincture, into a darkened room, into which a beam of the sun was admitted by a small aperture; and holding the phial sometimes near the sunbeams, and sometimes partly in them and partly out of them, changing also the position of the glass, and viewing it from several parts of the room, it exhibited a much greater variety of colours than it did in an enlightened room. Besides the usual colours, it was red in some places and green in others, and within were intermediate colours produced by the different mixtures of light and shade.

It was not only in this tincture of lignum nephriticum that Mr Boyle perceived the difference between reflected and transmitted light. He observed it even in gold, though no person explained the cause of these appearances before Sir Isaac Newton. He took a piece of leaf gold, and holding it betwixt his eye and the light, observed, that it did not appear of a golden colour, but of a greenish blue. He also observed the same change of colour by candle light; but the experiment did not succeed with a leaf of silver.

The constitution of the atmosphere and of the sea, we shall find, by more recent observations, to be similar to that of this infusion; for the blue rays, and others of a faint colour, do not penetrate so far into them as the red, and others of a stronger colour.

30 Mr Boyle's account of the colours of thin plates.

The first distinct account of the colours exhibited by thin plates of various substances is to be found among the observations of Mr Boyle. To show that colours may be made to appear or vanish, where there is no accession or change either of the sulphureous, the saline, or the mercurial principle of bodies, he observes, that all chemical essential oils, as also good spirit of wine, being shaken till they rise in bubbles, appear of various colours; which immediately vanish when the bubbles burst, so that a colourless liquor may be immediately made to exhibit a variety of colours, and lose them in a moment,

moment, without any change in its eſſential principles. He then mentions the colours that appear in bubbles of ſoap and water, and alſo in thoſe of turpentine. He ſometimes got glaſs blown ſo thin as to exhibit ſimilar colours; and obſerves, that a feather, and alſo a black ribbon, held at a proper diſtance, between his eye and the ſun, ſhowed a variety of little rainbows, with very vivid colours, none of which were conſtantly to be ſeen in the ſame objects.

31
Dr Hooke's account of theſe colours.

This ſubject was more carefully inveſtigated by Dr Hooke, who promiſed, at a meeting of the ſociety on the 7th of March 1672, to exhibit, at their next meeting, ſomething which had neither reflection nor refraction, and yet was diaphanous. Accordingly he produced the famous coloured bubble of ſoap and water of which ſuch uſe was afterwards made by Sir Iſaac Newton, but which Dr Hooke and his contemporaries ſeem to have overlooked in Mr Boyle's treatiſe on colours, though it was publiſhed nine years before. It is no wonder that ſo curious an appearance excited the attention of that inquiſitive body, and that they ſhould deſire him to bring an account of it in writing at their next meeting.

By the help of a ſmall glaſs pipe, there were blown ſeveral ſmall bubbles, out of a mixture of ſoap and water. At firſt, they appeared white and clear; but, after ſome time, the film of water growing thinner, there appeared upon it all the colours of the rainbow: Firſt, a pale yellow; then orange, red, purple, blue, green, &c. with the ſame ſeries of colours repeated; in which it was farther obſervable, that the firſt and laſt ſeries were very faint, and that the middlemoſt ſeries was very bright. After theſe colours had paſſed through the changes above mentioned, the film of the bubble began to appear white again; and preſently, in ſeveral parts of this ſecond white film, there were ſeen ſeveral holes, which by degrees grew very large, ſeveral of them running into one another.

Dr Hooke was the firſt who obſerved the beautiful colours that appear in thin plates of Muſcovy glaſs. With a microſcope he could perceive that theſe colours were ranged in rings ſurrounding the white ſpecks or flaws in this thin ſubſtance, that the order of the colours was the very ſame as in the rainbow, and that they were often repeated ten times. But the colours were diſpoſed as in the outer rainbow. Some of them alſo were much brighter than others, and ſome of them very much broader. He alſo obſerved, that if there was a part where the colours were very broad, and conſpicuous to the naked eye, they might be made, by preſſing the part with the finger, to change places, and move from one part to another. Laſtly, He obſerved, that if great care be uſed, this ſubſtance may ſplit into plates of $\frac{1}{8}$ or $\frac{1}{6}$ of an inch in diameter, each of which will appear through a microſcope to be uniformly adorned with ſome one vivid colour, and that theſe plates will be found upon examination to be of the ſame thickneſs throughout.

A phenomenon ſimilar to this was noticed by Lord Brereton, who at a meeting of the Royal Society in 1666, produced ſome pieces of glaſs taken out of a church window, both on the north and on the ſouth ſide of it; they were all eaten in by the air, but the piece taken from the ſouth ſide had ſome colours like thoſe of the rainbow upon it, which the others on the north ſide had not. It cannot be doubted, but that in all theſe caſes, the glaſs is divided into thin plates, which exhibit colours, upon the ſame principle with thoſe which Dr Hooke obſerved in the bubble of ſoap and water, and in the thin plate of glaſs, which we ſhall find more fully explained by Sir Iſaac Newton.

The enquiries of M. Bouguer concerning the reflection of light are worthy of particular notice. They are fully detailed in his *Traité d'Optique*, a poſthumous work publiſhed by La Caille in 1760.

32
Diſcoveries of M. Bouguer.

In order to compare different degrees of light, he always contrived to place the radiant bodies or other bodies illuminated by them, in ſuch a manner that he could view them diſtinctly at the ſame time; and he either varied the diſtances of theſe bodies, or modified their light in ſome other way, till he could perceive no difference between them. Then, conſidering their different diſtances, or the other circumſtances by which their light was affected, he calculated the proportion which they would have borne to each other at the ſame diſtance, or in the ſame circumſtances.

Plate CCCLXXV Fig. 3.

To aſcertain the quantity of light loſt by reflection, he placed the mirror, or reflecting ſurface, B, on which the experiment was to be made, truly upright; and having taken two tablets, of preciſely the ſame colour, or of an equal degree of whiteneſs, he placed them exactly parallel to one another at E and D, and threw light upon them by means of a lamp or candle, P, placed in a right line between them. He then placed himſelf ſo, that with his eye at A he could ſee the tablet E, and the image of the tablet D, reflected from the mirror B, at the ſame time, making them as it were, to touch one another. He then moved the candle along the line ED, ſo as to throw more or leſs light upon either of them, till he could perceive no difference in the ſtrength of the two lights that came to his eye. After this, he had nothing more to do than to meaſure the diſtances EP and DP, and then the intenſity of the lights was as $\overline{EP^2}$ to $\overline{DP^2}$.

Fig. 4.

To find how much light is loſt by oblique reflection, he took two equally poliſhed plates, D and E, and cauſed them to be enlightened by the candle P. While one of them, D, was ſeen at A, by reflection from B, placed in a poſition oblique to the eye, the other, E, was ſo placed, as to appear contiguous to it; and removing the plate E, till the light which it reflected was no ſtronger than that which came from the image D, ſeen by reflection at B, he eſtimated the quantity of light that was loſt by this oblique reflection, by the ſquares of the diſtances of the two objects from the candle.

Fig. 5.

In order to aſcertain the quantity of light loſt by reflection with the greateſt exactneſs, M. Bouguer introduced two beams of light into a darkened room, as by the apertures P and Q; which he had ſo contrived, that he could place them higher and lower, and enlarge or contract them at pleaſure; and the reflecting ſurface (as that of a fluid contained in a veſſel) was placed horizontally at O, from which the light coming through the hole P, was reflected to R, upon the ſcreen GH, where it was compared with another beam of light that fell upon S, through the hole Q; which he made ſo much leſs than P, as that the ſpaces S and R were equally illuminated; and by the proportion that the apertures P and Q bore to each other, he calculated what quantity of light was loſt by the reflection at O.

It was neceſſary, he obſerves, that the two beams of light PO and QS (which he uſually made 7 or 8 feet long) ſhould be exactly parallel, that they might come from two points of the ſky of the ſame altitude, and having preciſely the ſame intenſity of light. It was alſo neceſſary that the hole Q ſhould be a little higher than P, in order that the two images ſhould be at the ſame height, and near one another. It is no leſs neceſſary, he ſays, that the ſcreen GH be exactly vertical, in order that the direct and reflected beams may fall upon it, with the ſame inclination; ſince, otherwiſe, though the two lights were perfectly equal, they would not illuminate the ſcreen equally. This diſpoſition, he ſays, ſerves to anſwer another important condition in theſe experiments; for the direct ray QS muſt be of the ſame length with the ſum of the incident and reflected rays, PO and OR, in order that the quantity of light introduced into the room may be ſenſibly proportional to the ſizes of the apertures.

Before we proceed to detail the other experiments of Bouguer, we ſhall notice ſome which were made previous to them by Buffon on the diminution of light by reflection, and the tranſmiſſion of it to conſiderable diſtances through the air.

33 Experiment of M. Buffon.

By receiving the light of the ſun in a dark room, and comparing it with the ſame light of the ſun reflected by a mirror, he found that at ſmall diſtances, as four or five feet, about one half was loſt by reflection.

When the diſtances were 100, 200, and 300 feet, he could hardly perceive that it loſt any of its intenſity by being tranſmitted through ſuch a ſpace of air.

He afterwards made the ſame experiments with candles, in the following manner: He placed himſelf oppoſite to a looking glaſs, with a book in his hand, in a dark room; and having one candle lighted in the next room, at the diſtance of about 40 feet, he had it brought nearer to him by degrees, till he could juſt diſtinguiſh the letters of the book, which was then 24 feet from the candle. He then received the light of the candle, reflected by the looking glaſs, upon his book, carefully excluding all the light that was reflected from any thing elſe; and he found that the diſtance of the book from the candle, including the diſtance from the book to the looking glaſs (which was only half a foot) was in all 15 feet. He repeated the experiment ſeveral times, with nearly the ſame reſult; and therefore concluded, that the quantity of direct is to that of reflected light as 576 to 225; ſo that the light of five candles reflected from a plain mirror is about equal to that of two candles.

From theſe experiments it appeared, that more light was loſt by reflection of the candles than of the ſun, which M. Buffon thought was owing to this circumſtance, that the light iſſuing from the candle diverges, and therefore falls more obliquely upon the mirror than the light of the ſun, the rays of which are nearly parallel.

Theſe experiments and obſervations of M. Buffon, though curious, are inferior to thoſe of M. Bouguer, both in extent and accuracy.

34 Mr Bouguer's diſcoveries concerning the reflection of glaſs and poliſhed metal.

In order to aſcertain the difference in the quantity of light reflected by glaſs and poliſhed metal, he uſed a ſmooth piece of glaſs one line in thickneſs, and found that when it was placed at an angle of 15 degrees with the incident rays, it reflected 628 parts of 1000 which fell upon it; at the ſame time that a metallic mirror, which he tried in the ſame circumſtances, reflected only 561 of them. At a leſs angle of incidence much more light was reflected: ſo that at an angle of three degrees the glaſs reflected 700 parts, and the metal ſomething leſs, as in the former caſe.

In the caſe of unpoliſhed bodies, he found that a piece of white plaſter, placed at an angle of 75°, with the incident rays, reflected $\frac{1}{219}$ part of the light that is received from a candle nine inches from it. White paper, in the ſame circumſtances, reflected in the ſame proportion; but at the diſtance of three inches, they both reflected 150 parts out of 1000.

Proceeding to make farther obſervations on the ſubject of reflected light, he premiſes the two following theorems, which he demonſtrates geometrically. 1. When the luminous body is at an infinite diſtance, and its light is received by a globe, the ſurface of which has a perfect poliſh, and abſorbs no light, it reflects the light equally in all directions, provided it be received at a conſiderable diſtance. He excepts the place where the ſhadow of the globe falls: becauſe this is no more than a ſingle point, with reſpect to the immenſity of the ſpherical ſurface which receives the light.

2. The quantity of light reflected in one certain direction will always be exactly the ſame, whether it be reflected by a very great number of ſmall poliſhed hemiſpheres, by a leſs number of larger hemiſpheres, or by a ſingle hemiſphere, provided they occupy the ſame baſe, or cover the ſame ground plan.

The uſe he propoſes to make of theſe theorems is to aſſiſt him in diſtinguiſhing whether the light reflected from bodies be owing to the extinction of it within them, or whether the eminences which cover them have not the ſame effect as the ſmall poliſhed hemiſpheres above mentioned.

He begins with obſerving, that, of the light reflected from mercury, $\frac{1}{4}$ at leaſt is loſt, and that probably no ſubſtances reflect more than this. The rays were received at an angle of $11\frac{1}{2}$ degrees of incidence, that is meaſured from the ſurface of the reflecting body, and not from the perpendicular, which, he ſays, is what we are from this place to underſtand whenever he mentions the angle of incidence.

35 Great differences in the reflective power of ſubſtances according to the angle of incidence.

With regard to the quantities of light reflected at different angles of incidence, M. Bouguer found in general, that reflection is ſtronger at ſmall angles of incidence, and weaker at large ones. The difference is exceſſive when the rays ſtrike the ſurface of tranſparent ſubſtances, with different degrees of obliquity; but it is almoſt as great in ſome opaque ſubſtances, and it was always more or leſs ſo in every thing that he tried. He found the greateſt inequality in black marble, which, though not perfectly poliſhed, yet with an angle of 3° 35′ of incidence, it reflected almoſt as well as quickſilver. Of 1000 rays which it received, it returned 600: but when the angle of incidence was 14°, it reflected only 156; when it was 30°, it reflected 51; and when it was 80°, it reflected only 23.

Similar experiments made with metallic mirrors always gave the differences much leſs conſiderable. The greateſt was hardly ever an eighth or a ninth part of it, but they were always in the ſame way.

The great difference between the quantity of light reflected from the ſurface of water, at different angles of incidence, is truly ſurpriſing. M. Bouguer ſometimes ſuſpected, that, when the angles of incidence were

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very ſmall, the reflection from water was even greater than from quickſilver; though he rather thought that it was ſcarcely ſo great. In very ſmall angles, he ſays, that water reflects nearly $\frac{3}{4}$ of the direct light.

The light reflected from a lake is ſometimes $\frac{1}{3}$ or $\frac{1}{2}$, or even a greater proportion, of the light that comes directly from the ſun, which is an addition to the direct rays of the ſun that cannot fail to be very ſenſible. The direct light of the ſun diminiſhes gradually as it approaches the horizon, while the reflected light at the ſame time grows ſtronger: ſo that there is a certain altitude of the ſun, in which the united force of the direct and reflected light will be the greateſt poſſible, and this he ſays is 12 or 13 degrees.

The light reflected from water at great angles of incidence is extremely ſmall. M. Bouguer was aſſured, that, when the light was perpendicular, it reflected no more than the 37th part that quickſilver does in the ſame circumſtances; for it did not appear that water reflects more than the 60th, or rather the 55th, part of perpendicular light. When the angle of incidence was 50°, the light reflected from the ſurface of water was about the 32d part of that which mercury reflected; and as the reflection from water increaſes as the angle of incidence diminiſhes, it was twice as ſtrong in proportion at 39°; for it was then the 16th part of the quantity reflected from mercury.

In order to procure a common ſtandard by which to meaſure the proportion of light reflected from various fluid ſubſtances, he ſelected water as the moſt commodious; and partly by obſervation and calculation he drew up the following table of the quantity of light reflected from its ſurface at different angles of incidence.

Angles of incidence.	Rays reflected of 1000.	Angles of incidence.	Rays reflected of 1000
$\frac{1}{2}$	721	17 $\frac{1}{2}$	178
1	692	20	145
1 $\frac{1}{2}$	669	25	97
2	639	30	65
2 $\frac{1}{2}$	614	40	34
5	501	50	22
7 $\frac{1}{2}$	409	60	19
10	333	70	18
12 $\frac{1}{2}$	271	80	18
15	211	90	18

In the ſame manner, he conſtructed the following table containing the quantity of light reflected from the looking glaſs not quickſilvered.

Angles of incidence.	Rays reflected of 1000.	Angles of incidence.	Rays reflected of 1000.
$2\frac{1}{2}$	584	30	112
5	543	40	57
$7\frac{1}{2}$	474	50	34
10	412	60	27
$12\frac{1}{2}$	356	70	25
15	299	80	25
20	222	90	25
25	157		

When water floats upon mercury there will be two images of any object ſeen by reflection from them, one at the ſurface of the water, and the other at that of the quickſilver. In the largeſt angles of incidence, the image at the ſurface of the water will diſappear, which will happen when it is about a 60th or an 80th part leſs luminous than the image at the ſurface of the quickſilver. Depreſſing the eye, the image on the water will grow ſtronger, and that on the quickſilver weaker in proportion; till at laſt, the latter will be incomparably weaker than the former, and at an angle of about 10 degrees they will be equally luminous. According to the table, $\frac{333}{1000}$ of the incident rays are reflected from the water at this angle of 10 degrees. At the ſurface of the mercury they were reduced to 500; and of theſe, part being reflected back upon it from the under ſurface of the water, only 333 remained to make the image from the mercury.

36
Reflection of images by the air.

It has been frequently obſerved, that there is a remarkably ſtrong reflection into water, with reſpect to rays iſſuing from the water; and perſons under water have ſeen images of things in the air in a manner peculiarly diſtinct and beautiful. In order to account for theſe facts, M. Bouguer obſerves that from the ſmalleſt angles of incidence, to a certain number of degrees, the greateſt part of the rays are reflected, perhaps, in as great a proportion as at the ſurface of metallic mirrors, or of quickſilver; while the other part, which does not eſcape into the air, is extinguiſhed or abſorbed; ſo that the ſurface of the tranſparent body appears opaque on the inſide. If the angle of incidence be increaſed only a few degrees, the ſtrong reflection ceaſes altogether, a great number of rays eſcape into the air, and very few are abſorbed. As the angle of incidence is farther increaſed, the quantity of the light reflected becomes leſs and leſs; and when it is near 90 degrees, almoſt all the rays eſcape out of the tranſparent body, its ſurface loſing almoſt all its power of reflection, and becoming nearly as tranſparent as when the light falls upon it from without.

37
Extinction of the rays of light at the ſurface of tranſparent bodies.

This property belonging to the ſurfaces of tranſparent bodies, of abſorbing the rays of light, is truly remarkable, and, as there is reaſon to believe, had not been noticed by any perſon before M. Bouguer.

38
Strong reflection by a priſm.

That all the light is reflected at certain angles of incidence from air into denſer ſubſtances, had frequently been noticed, eſpecially in glaſs priſms; ſo that Newton made uſe of one of them, inſtead of a mirror, in the conſtruction of his reflecting teleſcope. If a beam of light fall upon the air from within theſe priſms, at an angle of 10, 20, or 30 degrees, the effect will be nearly the ſame as at the ſurface of quickſilver, one-fourth or one-third of the rays being extinguiſhed, and two-thirds or three-fourths reflected. This property retains its full force as far as an angle of 49° 49′, (the proportion of the ſines of the refraction being 31 and 20); but if the angle of incidence be increaſed but one degree, the quantity of light reflected inwards ſuddenly decreaſes, and a great part of the rays eſcape out of the glaſs, ſo that the ſurface becomes ſuddenly tranſparent.

All tranſparent bodies have the ſame property, with this difference, that the angle of incidence at which the ſtrong reflection ceaſes, and at which the light which is not reflected is extinguiſhed, is greater in ſome than in others. In water this angle is about 41° 32′; and in every medium it depends ſo much on the invariable proportion

proportion of the ſine of the angle of refraction to the ſine of the angle of incidence, that this law alone is ſufficient to determine all the phenomena of this new circumſtance, at leaſt as to this accidental opacity of the ſurface.

When M. Bouguer proceeded to meaſure the quantity of light reflected by theſe internal ſurfaces at great angles of incidence, he had to ſtruggle with many difficulties; but by uſing a plate of cryſtal, he found, that at an angle of 75 degrees, this internal reflection diminiſhed the light 27 or 28 times; and as the external reflection at the ſame angle diminiſhed the light only 26 times, it follows that the internal reflection is a little ſtronger than the other.

Repeating theſe experiments with the ſame and different pieces of cryſtal, he ſometimes found the two reflections to be equally ſtrong; but, in general, the internal was the ſtronger.

39 Of the quantity of light reflected by different ſubſtances.

Reſuming his obſervations on the diminution of light, occaſioned by the reflection of opaque bodies obliquely ſituated, he compared it with the appearances of ſimilar ſubſtances which reflected the light perpendicularly. Uſing pieces of ſilver made very white, he found, that, when one of them was placed at an angle of 75 degrees with reſpect to the light, it reflected only 640 parts out of 1000. He then varied the angle, and alſo uſed white plaſter and fine Dutch paper, and drew up the following table of the proportion of the light reflected from each of thoſe ſubſtances at certain angles.

Angles of incidence.	Quantity of Light reflected from Silver.	Plaſter.	Dutch Paper.
90	1000	1000	1000
75	802	762	971
60	640	640	743
45	455	529	507
30	319	352	332
15	209	194	203

Suppoſing the aſperities of opaque bodies to conſiſt of very ſmall planes, it appears from theſe obſervations, that there are fewer of them in thoſe bodies which reflect the light at ſmall angles of incidence than at greater. None of them had their roughneſs equivalent to ſmall hemiſpheres, which would have diſperſed the light equally in all directions; and, from the *data* in the preceding table, he deduces mathematically the number of the planes that compoſe thoſe ſurfaces, and that are inclined to the general ſurface at the angles above-mentioned, ſuppoſing that the whole ſurface contains 1000 of them that are parallel to itſelf, ſo as to reflect the light perpendicularly, when the luminous body is ſituated at right angles with reſpect to it. His concluſions reduced to a table, correſponding to the preceding, are as follow:

Inclinations of the ſmall ſurfaces with reſpect to the large one.	The diſtribution of the ſmall planes that conſtitute the aſperities of the opaque ſurface in the Silver.	Plaſter.	Paper.
0	1000	1000	1000
15	777	736	937
30	554	554	545
45	333	374	358
60	161	176	166
75	53	50	52

Theſe variations in the number of little planes, he expreſſes in the form of a curve; and afterwards ſhows, geometrically, what would be the effect if the bodies were enlightened in one direction, and viewed in another. Upon this ſubject he has ſeveral curious theorems and problems; but for theſe we muſt refer to the work itſelf.

40 Obſervations concerning the planets, &c.

Since the planets are more luminous at their edges than at their centres, he concludes, that the bodies which form them are conſtituted in a manner different from ours; particularly that their opaque ſurfaces conſiſt of ſmall planes, more of which are inclined to the general ſurface than they are in terreſtrial ſubſtances; and that there are in them an infinity of points, which have exactly the ſame ſplendour.

M. Bouguer next proceeds to aſcertain the quantity of ſurface occupied by the ſmall planes of each particular inclination, from conſidering the quantity of light reflected by each, allowing thoſe that have a greater inclination to the common ſurface to take up proportionably leſs ſpace than thoſe which are parallel to it. And comparing the quantity of light that would be reflected by ſmall planes thus diſpoſed, with the quantity of light that was actually reflected by the three ſubſtances above-mentioned, he found that plaſter, notwithſtanding its extreme whiteneſs, abſorbs much light; for that, of 1000 rays falling upon it, of which 166 or 167 ought to be reflected at an angle of 77°, only 67 are in fact returned; ſo that 100 out of 167 were extinguiſhed, that is, about three-fifths.

With reſpect to the planets, Bouguer concludes, that of 300,000 rays which the moon receives, 172,000, or perhaps 204,100, are abſorbed.

41 Of the ſurfaces of bodies.

Having conſidered the ſurfaces of bodies as conſiſting of planes only, he obſerves that each ſmall ſurface, ſeparately taken, is extremely irregular, ſome of them really concave, and others convex; but, in reducing them to a middle ſtate, they are to be regarded as planes. Nevertheleſs he conſiders them as planes only with reſpect to the reception of the rays; for as they are almoſt all curves, and as, beſides this, many of thoſe whoſe ſituation is different from others contribute to the ſame effects, the rays always iſſue from an actual or imaginary focus, and after reflection always diverge from another.

The experiments of Lambert, related in his *Photometria*, have laid open to us many curious obſervations concerning the natural hiſtory of light. He was the firſt who determined that a radiating ſurface emits its light with nearly the ſame intenſity in all directions, ſo

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that every portion of it appears equally bright to an observer placed in any direction.

42
Mr Melville's observations on the manner in which bodies are heated by light.

We are obliged to Mr Melville for ſome ingenious obſervations on the manner in which bodies are heated by light. He obſerves, that, as each colorific particle of an opaque body muſt be ſomewhat moved by the reflection of the particles of light, when it is reflected backwards and forwards between the ſame particles, it is manifeſt that they muſt likewiſe be agitated with a vibratory motion, and the time of a vibration will be equal to that which light takes up in moving from one particle of a body to another adjoining. This diſtance, in the moſt ſolid opaque bodies, cannot be ſuppoſed greater than $\frac{1}{12500}$th of an inch, which ſpace light deſcribes in the $\frac{1}{125000000000000}$th of a ſecond. With ſo rapid a motion, therefore, may the internal parts of bodies be agitated by the influence of light, as to perform 125,000,000,000,000 vibrations, or more, in a ſecond of time.

The arrival of different particles of light at the ſurface of the ſame colorific particle, in the ſame or different rays, may diſturb the regularity of its vibrations, but will evidently increaſe their frequency, or raiſe ſtill ſmaller vibrations among the parts which compoſe thoſe particles; whence the inteſtine motion will become more ſubtle, and more thoroughly diffuſed. If the quantity of light admitted into the body be increaſed, the vibrations of the particles muſt likewiſe increaſe in magnitude and velocity, till at laſt they may be ſo violent, as to make all the component particles daſh one another to pieces by their mutual colliſion; in which caſe, the colour and texture of the body muſt be deſtroyed.

Since there is no reflection of light but at the ſurface of a medium, the ſame gentleman obſerves, that the greateſt quantity of rays, though crowded into the ſmalleſt ſpace, will not of themſelves produce any heat. Hence it follows, that the portion of air which lies in the focus of the moſt potent ſpeculum, is not at all affected by the paſſage of light through it, but continues of the ſame temperature with the ambient air; though any opaque body, or even any tranſparent body denſer than air, when put in the ſame place, would, in an inſtant be intenſely heated.

The eaſieſt way to be ſatisfied of this truth experimentally is, to hold a hair, or a piece of down, immediately above the focus of a lens or ſpeculum, or to blow a ſtream of ſmoke from a pipe horizontally over it; for if the air in the focus were hotter than the ſurrounding fluid, it would continually aſcend on account of its rarefaction, and thereby ſenſibly agitate thoſe ſlender bodies. Or a lens may be ſo placed as to form its focus within a body of water, or ſome other tranſparent ſubſtance, the heat of which may be examined from time to time with a thermometer; but care muſt be taken, in this experiment, to hold the lens as near as poſſible to the tranſparent body, leſt the rays, by falling cloſer than ordinary on its ſurface, ſhould warm it more than the common ſunbeams. See Prieſtley on Viſion.

43
Abbé Nollet's experiments with burning glaſſes.

The attempts of the Abbé Nollet to fire inflammable ſubſtances by the concentration of the ſolar rays, have a near relation to the preſent ſubject. He attempted to fire liquid ſubſtances, but he was not able to do it either with ſpirit of wine, olive oil, oil of turpentine, or ether; and though he could fire ſulphur, yet he could not ſucceed with Spaniſh wax, roſin, black pitch, or ſuet. He both threw the focus of theſe mirrors upon the ſubſtances themſelves, and alſo upon the fumes that roſe from them; but the only effect was, that the liquor boiled, and was diſperſed in vapour or very ſmall drops. When linen rags, and other ſolid ſubſtances, were moiſtened with any of theſe inflammable liquids, they would not take fire till the liquid was diſperſed in a copious fume; ſo that the rags thus prepared were longer in burning than thoſe that were dry.

44
M. Beaume's experiments.

M. Beaume, who aſſiſted M. Nollet in ſome of theſe experiments, obſerved farther, that the ſame ſubſtances which were eaſily fired by the flame of burning bodies, could not be ſet on fire by the contact of the hotteſt bodies that did not actually flame. Neither ether nor ſpirit of wine could be fired with a hot coal, or even red-hot iron, unleſs they were of a white heat.

45
Bodies which ſeem to touch one another are not in actual contact.

By the help of optical principles, and eſpecially by obſervations on the reflection of light, Mr Melville demonſtrated that bodies which ſeem to touch one another are not always in actual contact. Upon examining the volubility and luſtre of drops of rain that lie on the leaves of colewort, and ſome other vegetables, he found that the luſtre of the drop is produced by a copious reflection of light from the flattened part of its ſurface contiguous to the plant. He found alſo, that, when the drop rolls along a part which has been wetted, it immediately loſes all its luſtre, the green plant being then ſeen clearly through it; whereas, in the other caſe, it is hardly to be diſcerned.

From theſe two obſervations, he concluded, that the drop does not really touch the plant, when it has the mercurial appearance, but is ſuſpended in the air at ſome diſtance from it by a repulſive force. For there could not be any copious reflection of white light from its under ſurface, unleſs there were a real interval between it and the ſurface of the plant.

If that ſurface were perfectly ſmooth, the under ſurface of the drop would be ſo likewiſe, and would therefore ſhow an image of the illuminating body by reflection, like a piece of poliſhed ſilver; but as it is conſiderably rough, the under ſurface becomes rough likewiſe, and thus by reflecting the light copiouſly in different directions, aſſumes the brilliant hue of unpoliſhed ſilver.

It being thus proved by an optical argument, that the drop is not really in contact with the leaf, it may eaſily be conceived whence its volubility ariſes, and why it leaves no moiſture where it rolls.

46
Two curious miſcellaneous obſervations.

Before we conclude the hiſtory of the obſervations concerning the reflection of light, we muſt not omit to take notice of two ſingular miſcellaneous obſervations. Baron Alexander Funk, viſiting ſome ſilver mines in Sweden, obſerved, that, in a clear day, it was as dark as pitch below ground, in the eye of a pit, at 60 or 70 fathoms deep; whereas, in a cloudy or rainy day, he could even ſee to read at the depth of 106 fathoms. He imagined that it aroſe from this circumſtance, that when the atmoſphere is full of clouds, light is reflected from them into the pit in all directions, and that thereby a conſiderable proportion of the rays are reflected perpendicularly upon the earth; whereas, when the atmoſphere is clear, there are no opaque bodies to reflect the light in this manner, at leaſt in a ſufficient quantity; and rays from the ſun itſelf can never fall perpendicularly in that country.

The

The other obſervation was that of the ingenious Mr Grey. He took a piece of ſtiff brown paper, and pricking a ſmall hole in it, he held it at a little diſtance before him; when, applying a needle to his eye, he was ſurpriſed to ſee the point of it inverted. The nearer the needle was to the hole, the more it was magnified, but the leſs diſtinct; and if it was ſo held, that its image was near the edge of the hole, its point ſeemed crooked. From theſe appearances he concluded, that theſe ſmall holes, or ſomething in them, produce the effects of concave ſpeculums; and from this circumſtance he took the liberty to call them *aërial ſpeculums*.

This method of accounting for the inverted image of the pin is evidently erroneous; for the ſame effect is produced, when the ſmall aperture is formed of two ſemi-apertures at different diſtances from the eye, or when a ſmall opening is made in the pigment on a piece of ſmoked glaſs. We have found indeed that the ſame phenomenon will appear, if, inſtead of looking at a hole in a piece of paper, we view a ſmall luminous point ſo that it is expanded by indiſtinct viſion into a circular image of light. The pin always increaſes in magnitude in proportion to its diſtance from the luminous point.

Sect. III. *Diſcoveries concerning the Inflection of Light.*

This property of light was not diſcovered till about the middle of the 17th century. The perſon who firſt made the diſcovery was Father Grimaldi; at leaſt he firſt publiſhed an account of it in his treatiſe *De lumine, coloribus, et iride*, printed in 1666. Dr Hooke, however, laid claim to the ſame diſcovery, though he did not make his obſervations public till ſix years after Grimaldi.

47 Dr Hooke's diſcoveries. Dr Hooke having darkened his room, admitted a beam of the ſun's light through a very ſmall hole in a braſs plate. This beam ſpreading itſelf, formed a cone, the vertex of which was in the hole, and the baſe was on a paper, ſo placed as to receive it at ſome diſtance. In the image of the ſun, thus painted on the paper, he obſerved that the middle was much brighter than the edges, and that there was a kind of dark penumbra about it, of about a 16th part of the diameter of the circle; which he aſcribed to a property of light, that he promiſed to explain.—Having obſerved this, at the diſtance of about two inches from the former he let in another cone of light; and receiving the baſes of them, at ſuch a diſtance from the holes that the circles interſected each other, he obſerved that there was not only a darker ring, encompaſſing the lighter circle, but a manifeſt dark line, or circle, as in fig. 6. which appeared even where the limb of the one interfered with that of the other. (Plate CCCLXXV Fig. 6.)

(Fig. 7.) In the light thus admitted, he held an opaque body BB, fig. 7. ſo as to intercept the light that entered at a hole in the window ſhutter O, and was received on the ſcreen AP. In theſe circumſtances, he obſerved, that the ſhadow of the opaque body (which was a round piece of wood, not bright or poliſhed) was all over ſomewhat enlightened, but more eſpecially towards the edge. In order to ſhow that this light was not produced by reflection, he admitted the light through a hole burnt in a piece of paſteboard, and intercepted it with a razor which had a very ſharp edge; but ſtill the appearances were the very ſame as before; ſo that he concluded that they were occaſioned by ſome new property of light.

He diverſified this experiment, by placing the razor ſo as to divide the cone of light into two parts, and placing the paper ſo that none of the enlightened part of the circle fell upon it, but only the ſhadow of the razor; and, to his great ſurpriſe, he obſerved what he calls a *very briſk and viſible radiation* ſtriking down upon the paper, of the ſame breadth with the diameter of the lucid circle. This radiation always ſtruck perpendicularly from the line of ſhadow, and, like the tail of a comet, extended more than 10 times the breadth of the remaining part of the circle. He found, wherever there was a part of the interpoſed body higher than the reſt, that, oppoſite to it, the radiation of light into the ſhadow was brighter, as in the figure; and wherever there was a notch or gap in it, there would be a dark ſtroke in the half-enlightened ſhadow. From all theſe appearances, he concluded, that there is a deflection of light, differing both from reflection and refraction, and ſeeming to depend on the unequal denſity of the conſtituent parts of the ray, whereby the light is diſperſed from the place of condenſation, and rarefied, or gradually diverged into a quadrant; that this deflection is made towards the ſuperficies of the opaque body perpendicularly; that thoſe parts of the diverged radiations which are deflected by the greateſt angle from the ſtraight or direct radiations are the fainteſt, and thoſe that are deflected by the leaſt angles are the ſtrongeſt; that rays cutting each other in one common aperture do not make the angles at the vertex equal; that colours may be made without refraction; that the diameter of the ſun cannot be truly taken with common ſights; that the ſame rays of light, falling upon the ſame point of an object, will turn into all ſorts of colours, by the various inclinations of the object; and that colours begin to appear when two pulſes of light are blended ſo well, and ſo near together, that the ſenſe takes them for one.

We ſhall now proceed to give an account of the diſcoveries of Father Grimaldi. Having introduced a ray of light, through a very ſmall hole, AE, fig. 8. into a darkened room, he obſerved that the light was diffuſed in the form of a cone, the baſe of which was CD; and that if any opaque body, FE, was placed in this cone of light, at a conſiderable diſtance from the hole, and the ſhadow received upon a piece of white paper, the boundaries of it were not confined within GH, or the penumbra IL, occaſioned by the light proceeding from different parts of the aperture, and of the diſk of the ſun, but extended to MN: At this he was very much ſurpriſed, as he found that it was broader than it ought to have been made by rays paſſing in right lines by the edges of the object. 48 Grimaldi's diſcoveries. Fig. 8.

But the moſt remarkable circumſtance in this appearance was, that upon the lucid part of the baſe, CM and ND, ſtreaks of coloured light were plainly diſtinguiſhed, each being terminated by blue on the ſide next the ſhadow, and by red on the other; and though theſe coloured ſtreaks depended, in ſome meaſure on the ſize of the aperture AB, becauſe they could not be made to appear if it was large, yet he found that they were not limited either by it, or by the diameter of the ſun's diſk.

He farther obſerved, that theſe coloured ſtreaks were

History. were not all of the ſame breadth, but grew narrower as they receded from the ſhadow, and were each of them broader the farther the ſhadow was received from the opaque body, and alſo the more obliquely the paper on which they were received was held with reſpect to it. He never obſerved more than three of theſe ſtreaks.

Fig. 9. To give a clearer idea of theſe coloured ſtreaks, he drew the repreſentation of them, exhibited in fig. 9. in which NMO repreſents the largeſt and moſt luminous ſtreak, next to the dark ſhadow X. In the ſpace in which M is placed there was no diſtinction of colour, but the ſpace NN was blue, and the ſpace OO on the other ſide of it was red. The ſecond ſtreak QPR was narrower than the former; and of the three parts of which it conſiſted, the ſpace P had no particular colour, but QQ was a faint blue, and RR a faint red. The third ſtreak, TSV, was exactly ſimilar to the two others, but narrower than either of them, and the colour ſtill fainter.

Theſe coloured ſtreaks he obſerved to lie parallel to the ſhadow of the opaque body; but when it was of an angular form, they did not make the ſame acute angles, but were bent into a curve, the outermoſt being rounder than thoſe that were next the ſhadow, as is repreſented in fig. 10. If it was an inward angle, as DCH, Fig. 10. the coloured ſtreaks, parallel to each other of the two ſides croſſed without obliterating one another; only the colours were thus rendered either more intenſe or mixed.

Within the ſhadow itſelf, Grimaldi ſometimes perceived coloured ſtreaks, ſimilar to thoſe above mentioned on the outſide of the ſhadow. Sometimes he ſaw more of them, and ſometimes fewer; but for this purpoſe it was neceſſary to have ſtrong light, and to make the opaque body long and moderately broad. A hair, for inſtance, or a fine needle, did not anſwer ſo well as a thin and narrow plate: and the ſtreaks were moſt diſtinguiſhable when the ſhadow was taken at the greateſt diſtance; though the light grew fainter in the ſame proportion.

The numbers of theſe ſtreaks increaſed with the breadth of the plate. They were at leaſt two, and ſometimes four, if a thicker plate were made uſe of. But, with the ſame plate, more or fewer ſtreaks appeared, in proportion to the diſtance at which the ſhadow was received; but they were broader when they were few, and narrower when there were more of them; and they were all much more diſtinct when the paper was held obliquely.

Theſe coloured ſtreaks, like thoſe on the outſide of the ſhadow, were bent in an arch, round the acute angles of the ſhadow, as they are repreſented in fig. 11. Fig. 11. At this angle alſo, as at D, other ſhorter lucid ſtreaks were viſible, bent in the form of a plume, as they are drawn betwixt D and C, each bending round and meeting again in D. Theſe angular ſtreaks appeared, though the plate or rod was not wholly immerſed in the beam of light, but the angle of it only; and they increaſed in number with the breadth of the plate. If the plate was very thin, the coloured ſtreaks bent round from the oppoſite ſides, and met one another as at B.

In order to obtain a more ſatisfactory proof, that rays of light really bend, in paſſing by the edges of bodies, he admitted a beam of light into a dark room, as before; and, at a great diſtance from it, he fixed a plate EF, (fig. 12.) with a ſmall aperture, GH, which admitted only a part of the beam of light, and found, that when Fig. 12. the light tranſmitted through this plate was received at ſome diſtance upon a white paper, the baſe IK was conſiderably larger than it could poſſibly have been made by rays iſſuing in right lines through the two apertures. Grimaldi generally made the aperture CD $\frac{4}{100}$ or $\frac{5}{100}$ part of a foot, and the ſecond aperture, GH, $\frac{25}{100}$ or $\frac{30}{100}$; and the diſtances DG and GN, were, at leaſt, 12 feet. The obſervation was made about mid-day in the ſummer time, when the atmoſphere was free from all vapours.

Grimaldi alſo made the ſame experiment that has been recited from Dr Hooke, in which two beams of light, entering a dark room by two ſmall apertures near one another, projected cones of light, which, at a certain diſtance, in part coincided; and he particularly obſerved, that the dark boundaries of each of them were viſible within the lucid ground of the other.

To theſe diſcoveries of Grimaldi, we ſhall ſubjoin an additional obſervation of Dechales; who found, that if a piece of poliſhed metal, with ſmall ſcratches in it, be expoſed to the beams of the ſun in a darkened room, it will reflect the rays ſtreaked with colours in the direction of the ſcratches; as will appear, if the reflected light be received upon a piece of white paper. That theſe colours are not produced by refraction, he ſays, is manifeſt; for if the ſcratches be made upon glaſs, the effect will be the ſame; and in this caſe, if the light had been refracted at the ſurface of the glaſs, it would have been tranſmitted through it. From theſe and many other obſervations, he concluded, that colour does not depend upon the refraction of light only, nor upon a variety of other circumſtances, which he particularly enumerates, but upon the intenſity of the light only. 49 Obſervation of Dechales.

We ſhall here give an account of a phenomenon of viſion obſerved by M. de la Hire, as being connected with the ſubject of this ſection. When we look at a candle, or any luminous body, with our eyes nearly ſhut, rays of light are extended from it, in ſeveral directions, to a conſiderable diſtance, like the tails of comets. This appearance exerciſed the ſagacity of Deſcartes and Rohault, as well as of De la Hire; but all theſe philoſophers ſeem to have been miſtaken with regard to its cauſe. Deſcartes aſcribed this effect to certain wrinkles in the ſurface of the humours of the eyes. Rohault ſays, that when the eye-lids are nearly cloſed, the edges of them act like convex lenſes. But De la Hire obſerves. that the moiſture on the ſurface of the eye, adhering partly to the eye itſelf, and partly to the edge of the eye-lid, makes a concave mirror, and ſo diſperſes the rays at their entrance into the eye. The true account of the phenomenon, however, is this. There are three different kinds of radiations diſtinctly viſible; the moſt brilliant, which diverge directly from the candle, are formed by the *refraction* of the light of the candle through the moiſture that lubricates the eye, and which is brought oppoſite the pupil by one of the eye-lids. Another kind of radiation, which appears at a diſtance from the candle in the form of ſmall luminous ſpecks, is produced by *reflection* from the part of the eye-lid in which the laſhes are 50 Of M. de la Hire.

are inſerted. The third kind of radiation is horizontal, and is cauſed by the *inflection* of the light in paſſing between the eye-laſhes.

51
Sir Iſaac Newton's diſcoveries.

The experiments of Grimaldi and Hooke were repeated and extended by Sir Iſaac Newton, and were in ſome meaſure explained by that diſtinguiſhed philoſopher.

He made in a piece of lead a ſmall hole the 42d part of an inch in diameter. Through this hole he let into his dark chamber a beam of the ſun's light; and found, that the ſhadows of hairs, and other ſlender ſubſtances, placed in it, were conſiderably broader than they would have been if the rays of light had paſſed by thoſe bodies in right lines. He therefore concluded, that they muſt have paſſed as they are repreſented in fig. 1. in which X repreſents a ſection of the hair, and AD, BE, &c. rays of light paſſing by at different diſtances, and then falling upon the wall GQ. Since, when the paper which receives the rays is at a great diſtance from the hair, the ſhadow is broad, it muſt follow, that the hair acts upon the rays at ſome conſiderable diſtance from it, the action being ſtrongeſt on thoſe rays which are at the leaſt diſtance, and growing weaker and weaker on thoſe which are farther off, as is repreſented in this figure; and hence it comes to paſs that the ſhadow of the hair is much broader in proportion to the diſtance of the paper from the hair when it is nearer than when it is at a greater diſtance.

Plate CCCLXXVI. fig. 1.

By wetting a poliſhed plate of glaſs, and laying the hair in the water upon the glaſs, and then laying another poliſhed plate of glaſs upon it, ſo that the water might fill up the ſpace between the glaſſes, he found that the ſhadow at the ſame diſtance was as big as before, ſo that this breadth of ſhadow muſt proceed from ſome other cauſe than the refraction of the air.

The ſhadows of all bodies placed in this light were bordered with three parallel fringes of coloured light, of which that which was neareſt to the ſhadow was the broadeſt and moſt luminous, while that which was fartheſt from it was the narroweſt, and ſo faint as to be ſcarcely viſible. It was difficult to diſtinguiſh theſe colours, unleſs when the light fell very obliquely upon ſome ſmooth white body, ſo as to make them appear much broader than they would otherwiſe have done; but in theſe circumſtances the colours were plainly viſible, and in the following order. The firſt or innermoſt fringe was violet, and deep blue next the ſhadow, light blue, green, and yellow in the middle, and red without. The ſecond fringe was almoſt contiguous to the firſt, and the third to the ſecond; and both were blue within, and yellow and red without; but their colours were very faint, eſpecially thoſe of the third. The colours, therefore, proceeded in the following order from the ſhadow; violet, indigo, pale blue, green, yellow, red; blue, yellow, red; pale blue, pale yellow, and red. The ſhadows, made by ſcratches and bubbles in poliſhed plates of glaſs were bordered with the like fringes of coloured light.

Meaſuring theſe fringes and their intervals with the greateſt accuracy, he found the former to be in the progreſſion of the numbers 1, $\sqrt{\frac{1}{3}}$, $\sqrt{\frac{1}{5}}$, and their intervals to be in the ſame progreſſion with them, that is, the fringes and their intervals together to be nearly in continual progreſſion of the numbers, 1, $\sqrt{\frac{1}{2}}$, $\sqrt{\frac{1}{3}}$, $\sqrt{\frac{1}{4}}$, $\sqrt{\frac{1}{5}}$.

Having made the aperture $\frac{3}{4}$ of an inch in diameter, and admitted the light as formerly, Sir Iſaac placed, at the diſtance of two or three feet from the hole, a ſheet of paſteboard, black on both ſides; and in the middle of it he made a hole about $\frac{1}{4}$ of an inch ſquare, and behind the hole he faſtened to the paſteboard the blade of a ſharp knife, to intercept ſome part of the light which paſſed through the hole. The planes of the paſteboard and blade of the knife were parallel to each other, and perpendicular to the rays; and when they were ſo placed that none of the light fell on the paſteboard, but all of it paſſed through the hole to the knife, and there part of it fell upon the blade of the knife, and part of it paſſed by its edge, he let that part of the light which paſſed fall on a white paper, 2 or 3 feet beyond the knife, and there he ſaw two ſtreams of faint light ſhoot out both ways from the beam of light into the ſhadow. But becauſe the ſun's direct light, by its brightneſs upon the paper, obſcured theſe faint ſtreams, ſo that he could ſcarcely ſee them, he made a little hole in the midſt of the paper for that light to paſs through and fall on a black cloth behind it; and then he ſaw the two ſtreams plainly. They were ſimilar to one another, and pretty nearly equal in length, breadth, and quantity of light. Their light, at that end which was next to the ſun's direct light, was pretty ſtrong for the ſpace of about $\frac{1}{4}$ of an inch, or $\frac{1}{2}$ of an inch, and gradually decreaſed till it became inſenſible.

The whole length of either of theſe ſtreams, meaſured upon the paper, at the diſtance of 3 feet from the knife, was about 6 or 8 inches; ſo that it ſubtended an angle, at the edge of the knife, of about 10 or 12, or at moſt 14, degrees. Yet ſometimes be thought he ſaw it ſhoot 3 or 4 degrees farther; but with a light ſo very faint, that he could hardly perceive it. This light he ſuſpected might, in part at leaſt, ariſe from ſome other cauſe than the two ſtreams. For, placing his eye in that light, beyond the end of that ſtream which was behind the knife, and looking towards the knife, he could ſee a line of light upon its edge; and that not only when his eye was in the line of the ſtreams, but alſo when it was out of that line, either towards the point of the knife, or towards the handle. This line of light appeared contiguous to the edge of the knife, and was narrower than the light of the innermoſt fringe, and narroweſt when his eye was fartheſt from the direct light; and therefore ſeemed to paſs between the light of that fringe and the edge of the knife; and that which paſſed neareſt the edge ſeemed to be moſt bent.

He then placed another knife by the former, ſo that their edges might be parallel, and look towards one another, and that the beam of light might fall upon both the knives, and ſome part of it paſs between their edges. In this ſituation he obſerved, that when the diſtance of their edges was about the 400th of an inch, the ſtream divided in the middle, and left a ſhadow between the two parts. This ſhadow was ſo dark, that all the light which paſſed between the knives ſeemed to be bent to the one hand or the other; and as the knives ſtill approached each other, the ſhadow grew broader and the ſtreams ſhorter next to it, till, upon the contact of the knives, all the light vaniſhed.

Hence Sir Iſaac concluded, that the light which is leaſt bent, and which goes to the inward ends of the ſtreams, paſſes by the edges of the knives at the greateſt diſtance;

distance; and this distance, when the shadow began to appear between the streams, was about the 800th of an inch; and the light which passed by the edges of the knives at distances still less and less, was more and more faint, and went to those parts of the streams which were farther from the direct light; because, when the knives approached one another till they touched, those parts of the stream vanished last which were farthest from the direct line.

In the experiment of one knife only, the coloured fringes did not appear; but, on account of the breadth of the hole in the window, became so broad as to run into one another, and, by joining, to make one continual light in the beginning of the streams; but in the last experiment, as the knives approached one another, a little before the shadow appeared between the two streams, the fringes began to appear on the inner ends of the streams, on either side of the direct light; three on one side, made by the edge of one knife, and three on the other side, made by the edge of the other knife. They were the most distinct when the knives were placed at the greatest distance from the hole in the window, and became still more distinct by making the hole less; so that he could sometimes see a faint trace of a fourth fringe beyond the three above mentioned: and as the knives approached one another the fringes grew more distinct and larger, till they vanished; the outermost vanishing first, and the innermost last. After they were all vanished, and the line of light in the middle between them was grown very broad, extending itself on both sides into the streams of light described before, the above-mentioned shadow began to appear in the middle of this line, and to divide it along the middle into two lines of light, and increased till all the light vanished. This enlargement of the fringes was so great, that the rays which went to the innermost fringe seemed to be bent about 20 times more when the fringe was ready to vanish, than when one of the knives was taken away.

From both these experiments Newton concluded, that the light of the first fringe passed by the edge of the knife at a distance greater than the 800th of an inch; that the light of the second fringe passed by the edge of the knife at a greater distance than the light of the first fringe, and that of the third at a greater distance than that of the second; and that the light of which the streams above mentioned consisted, passed by the edges of the knives at less distances than that of any of the fringes.

He then got the edges of two knives ground straight, and fixed their points into a board, so that their edges might contain a rectilinear angle. The distance of the edges of the knives from one another, at four inches from the angular point, was the 8th of an inch; so that the angle contained by their edges was about $1^{\circ}\ 54'$. The knives being thus fixed, he placed them in a beam of the sun's light let into his darkened chamber, through a hole the 42d of an inch wide, at the distance of 10 or 13 feet from the hole; and he let the light which passed between their edges fall very obliquely on a smooth white ruler, at the distance of $\frac{1}{2}$ inch, or an inch, from the knives; and there he saw the fringes made by the two edges of the knives run along the edges of the shadows of the knives, in lines parallel to those edges, without growing sensibly broader, till they met in angles equal to the angle contained by the edges of the knives; and where they met and joined, they ended, without crossing one another. But if the ruler was held at a much greater distance from the knives, the fringes, where they were farther from the place of their meeting, were a little narrower, and they became something broader as they approached nearer to one another, and after they met they crossed one another, and then became much broader than before.

From these observations he concluded, that the distances at which the light composing the fringes passed by the knives were not increased or altered by the approach; and that the knife which was nearest to any ray determined which way the ray should be bent, but that the other knife increased the bending.

When the rays fell very obliquely upon the ruler, at the distance of $\frac{1}{3}$ of an inch from the knives, the dark line between the first and second fringe of the shadow of one knife, and the dark line between the first and second fringe of the shadow of the other knife, met one another, at the distance of $\frac{1}{5}$ of an inch from the end of the light which passed between the knives, where their edges met; so that the distance of the edges of the knives, at the meeting of the dark lines, was the 160th of an inch; and one half of that light passed by the edge of one knife, at a distance not greater than the 320th part of an inch, and, falling upon the paper, made the fringes of the shadow of that knife; while the other half passed by the edge of the other knife, at a distance not greater than the 320th part of an inch, and, falling upon the paper, made the fringes of the shadow of the other knife. But if the paper was held at a distance from the knives greater than $\frac{1}{3}$ of an inch, the dark lines above mentioned met at a greater distance than $\frac{1}{5}$ of an inch from the end of the light which passed between the knives, at the meeting of their edges; so that the light which fell upon the paper where those dark lines met passed between the knives, where their edges were farther distant than the 160th of an inch. For at another time, when the two knives were 8 feet 5 inches from the little hole in the window, the light which fell upon the paper where the above-mentioned dark lines met passed between the knives, where the distance between their edges was, as in the following table, at the distances from the paper noted.

Distances of the paper from the knives in inches.	Distance between the edges of the knives in thousandth parts of an inch.
$1\frac{1}{2}$	0,012
$3\frac{1}{3}$	0,020
$8\frac{3}{5}$	0,034
32	0,057
96	0,081
131	0,087

From these observations he concluded, that the light which forms the fringes upon the paper is not the same light at all distances of the paper from the knives; but that when the paper is held near the knives, the fringes are made by light which passes by the

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the edges of the knives at a less distance, and is more bent than when the paper is held at a greater distance from the knives.

When the fringes of the shadows of the knives fell perpendicularly upon the paper, at a great distance from the knives, they were in the form of hyperbolas, of the following dimensions. Let CA, CB, (fig. 2.) represent lines drawn upon the paper, parallel to the edges of the knives; and between which all the light would fall if it suffered no inflection. DE is a right line drawn through C, making the angles ACD, BCE, equal to one another, and terminating all the light which falls upon the paper, from the point where the edges of the knives meet. Then eis, fkt, and glv, will be three hyperbolic lines, representing the boundaries of the shadow of one of the knives, the dark line between the first and second fringes of that shadow, and the dark line between the second and third fringes of the same shadow. Also xip, ykq, and zlr, will be three other hyperbolic lines, representing the boundaries of the shadow of the other knife, the dark line between the first and second fringes of that shadow, and the dark line between the second and third fringes of the same shadow. These three hyperbolas which are similar, and equal to the former, cross them in the points i, k, and l; so that the shadows of the knives are terminated, and distinguished from the first luminous fringes, by the lines eis and xip, till the meeting and crossing of the fringes; and then those lines cross the fringes in the form of dark lines terminating the first luminous fringes on the inside, and distinguishing them from another light, which begins to appear at i, and illuminates all the triangular space ip DE s, comprehended by these dark lines and the right line DE. Of these hyperbolas one asymptote is the line DE, and the other asymptotes are parallel to the lines CA and CB.

Plate CCCLXXVI. fig. 2.

Before the small hole in the window Newton placed a prism, to form on the opposite wall the coloured image of the sun; and he found that the shadows of all bodies held in the coloured light, were bordered with fringes of the colour of the light in which they were held; and he found that those made in the red light were the largest, those made in the violet the least, and those made in the green of a middle bigness. The fringes with which the shadow of a man's hair were surrounded, being measured across the shadow, at the distance of six inches from the hair, the distance between the middle and most luminous part of the first or innermost fringe on one side of the shadow, and that of the like fringe on the other side of the shadow, was, in the full red light $\frac{1}{37.5}$ of an inch, and in the full violet $\frac{1}{46}$. The like distance between the middle and most luminous parts of the second fringes, on either side of the shadow, was in the full red light $\frac{1}{22}$ and in the violet $\frac{1}{27}$ of an inch; and these distances of the fringes held the same proportion at all distances from the hair, without any sensible variation.

From these observations it was evident, that the rays which formed the fringes in the red light, passed by the hair at a greater distance than those which made the like fringes in the violet; so that the hair, in causing these fringes, acted alike upon the red light or least refrangible rays at a greater distance, and upon the violet or most refrangible rays at a less distance; and thereby occasioned fringes of different sizes, without any change in the colour of any sort of light.

It may therefore be concluded, that when the hair was held in the white beam of light, and cast a shadow bordered with three coloured fringes, those colours arose not from any new modifications impressed upon the rays of light by the hair, but only from the various inflections by which the several sorts of rays were separated from one another, which before separation, by the mixture of all their colours, composed the white beam of the sun's light; but, when separated, composed lights of the several colours which they are originally disposed to exhibit.

52 Maraldi's discoveries.

The person who first made any experiments similar to those of Newton on inflected light is M. Maraldi. His observations chiefly respect the inflection of light towards other bodies, whereby their shadows are partially illuminated.

53 Experiments concerning the shadows of cylinders.

He exposed in the light of the sun a cylinder of wood three feet long, and $6\frac{1}{2}$ lines in diameter, when its shadow was everywhere equally black and well defined, even at the distance of 23 inches from it. At a greater distance the shadow appeared of two different densities; for its two extremities, in the direction of the length of the cylinder, were terminated by two dark strokes, a little more than a line in breadth. Within these dark lines there was a faint light, equally dispersed through the shadow, which formed an uniform penumbra, much lighter than the dark strokes at the extremity, or than the shadow received near the cylinder. This appearance is represented in Plate CCCLXXVI. fig. 3.

Fig. 3.

As the cylinder was removed to a greater distance from the paper, the two black lines continued to be nearly of the same breadth, and the same degree of obscurity; but the penumbra in the middle grew lighter, and its breadth diminished, so that the two dark lines at the extremity of the shadow approached one another, till at the distance of 60 inches, they coincided, and the penumbra in the middle entirely vanished. At a still greater distance a faint penumbra was visible; but it was ill defined, and grew broader as the cylinder was removed farther off, but was sensible at a very great distance.

Besides the black and dark shadow which the cylinder formed near the opaque body, a narrow and faint penumbra was seen on the outside of the dark shadow. And on the outside of this there was a tract more strongly illuminated than the rest of the paper.

The breadth of the external penumbra increased with the distance of the shadow from the cylinder, and the breadth of the tract of light on the outside of it was also enlarged; but its splendour diminished with the distance.

He repeated these experiments with three other cylinders of different dimensions; and from all of them he inferred, that every opaque cylindrical body, exposed to the light of the sun, makes a shadow which is black and dark to the distance of 38 to 45 diameters of the cylinder which forms it; and that, at a greater distance, the middle part begins to be illuminated in the manner described above.

In explaining these appearances, Maraldi supposes that

that the light which diluted the middle part of the ſhadow was occaſioned by the inflection of the rays, which, bending inwards on their near approach to the body, did at a certain diſtance enlighten all the ſhadow, except the edges, which were left undiſturbed. At the ſame time other rays were deflected from the body, and formed a ſtrong light on the outſide of the ſhadow, and which might at the ſame time contribute to dilute the outer ſhadow, though he ſuppoſed that penumbra to be occaſioned principally by that part of the paper not being enlightened, except by a part of the ſun's diſk only, according to the known principles of optics.

54 Concerning thoſe of globes.

The ſame experiments he made with globes of ſeveral diameters; but he found, that the ſhadows of the globes were not viſible beyond 15 of their diameters; which he thought was owing to the light being inflected on every ſide of a globe, and conſequently in ſuch a quantity as to diſperſe the ſhadows ſooner than in the caſe of the cylinders.

In repeating the experiments of Grimaldi and Newton, he obſerved that, beſides the enlarged ſhadow of a hair, a fine needle, &c. the bright gleam of light that bordered it, and the three coloured fringes next to this enlightened part, when the ſhadow was at a conſiderable diſtance from the hair, the dark central ſhadow was divided in the middle by a mixture of light; and that it was not of the ſame denſity, except when it was very near the hair.

A briſtle, at the diſtance of nine feet from the hole, made a ſhadow, which, being received at five or ſix feet from the object, he obſerved to conſiſt of ſeveral ſtreaks of light and ſhade. The middle part was a faint ſhadow, or rather a kind of penumbra, bordered by a darker ſhadow, and after that by a narrower penumbra; next to which was a light ſtreak broader than the dark part, and next to the ſtreak of light, the red, violet, and blue colours were ſeen as in the ſhadow of the hair.

55 Experiments concerning the ſhadows of plates.

A plate, two inches long, and about half a line broad, being fixed perpendicularly to the rays, at the diſtance of nine feet from the hole, a faint light was ſeen uniformly diſperſed over the ſhadow, when it was received perpendicularly to it, and very near. The ſhadow of the ſame plate, received at the diſtance of two feet and a half, was divided into four narrow black ſtreaks, ſeparated by ſmall lighter intervals equal to them. The boundaries of this ſhadow on each ſide had a penumbra, which was terminated by a very ſtrong light, next to which were the coloured ſtreaks of red, violet, and blue, as before. This is repreſented in Plate CCCLXXVI. fig. 4. Fig. 4.

The ſhadow of the ſame plate, at $4\frac{1}{2}$ feet diſtance from it, was divided into two black ſtreaks only, the two outermoſt having diſappeared, as in fig. 5.; but theſe two black ſtreaks which remained were broader than before, and ſeparated by a lighter ſhade, twice as broad as one of the former black ſtreaks, when the ſhadow was taken at $2\frac{1}{2}$ feet. This penumbra in the middle had a tinge of red. After the two black ſtreaks there appeared a pretty ſtrong penumbra, terminated by the two ſtreaks of light, which were now broad and ſplendid, after which followed the coloured ſtreaks. Fig. 5.

A ſecond plate, 2 inches long and a line broad, being placed, 14 feet from the hole, its ſhadow was received perpendicularly very near the plate, and was found to be illuminated by a faint light, equally diſperſed, as in the caſe of the preceding plate. But being received at the diſtance of 13 feet from the plate, ſix ſmall black ſtreaks began to be viſible, as in fig. 6. At 17 feet the black ſtreaks were broader, more diſtinct, and more ſeparated from the ſtreaks that were leſs dark. At 42 feet, only two black ſtreaks were ſeen in the middle of the penumbra, as in fig. 7. This middle penumbra between the two black ſtreaks was tinged with red. Next to the black ſtreaks there always appeared the ſtreaks of light, which were broad, and the coloured ſtreaks next to them. At the diſtance of 72 feet, the appearances were the ſame as in the former ſituation, except that the two black ſtreaks were broader, and the interval between them, occupied by the penumbra, was broader alſo, and tinged with a deeper red. With plates from $\frac{1}{4}$ line to 2 lines broad, he could not obſerve any of the ſtreaks of light, though the ſhadows were in ſome caſes 56 feet from them. Fig. 6. Fig. 7.

The extraordinary ſize of the ſhadows of ſmall ſubſtances M. Maraldi thought to be occaſioned by the ſhadow from the enlightened part of the ſky, added to that which was made by the light of the ſun, and alſo to a vortex occaſioned by the circulation of the inflected light behind the object.

Maraldi having made the preceding experiments upon ſingle long ſubſtances, placed two of them ſo as to croſs one another in a beam of the ſun's light. The ſhadows of two hairs placed in this manner, and received at ſome diſtance from them, appeared to be painted reciprocally one upon the other, ſo that the obſcure part of one of them was viſible upon the obſcure part of the other. The ſtreaks of light alſo croſſed one another, and the coloured ſtreaks did the ſame.

He alſo placed in the rays of the ſun a briſtle and a plate of iron a line thick, ſo that they croſſed one another obliquely; and when their ſhadows were received at the ſame diſtance, the light and dark ſtreaks of the ſhadow of the briſtle were viſible ſo far as the middle of the ſhadow of the plate on the ſide of the acute angle, but not on the ſide of the obtuſe angle, whether the briſtle or the plate were placed next to the rays. The plate made a ſhadow ſufficiently dark, divided into ſix black ſtreaks; and theſe were again divided by as many light ones equal to them; and yet all the ſtreaks belonging to the ſhadow of the briſtle were viſible upon it, as in fig. 8. To explain this appearance, he ſuppoſed that the rays of the ſun glided a little along the briſtle, ſo as to enlighten part of that which was behind the plate. But this ſeems to be an arbitrary and improbable ſuppoſition. Fig. 8.

M. Maraldi alſo placed ſmall globes in the ſolar light, admitted through a ſmall aperture, and compared their ſhadows with thoſe of the long ſubſtances, as he had done in the day light, and the appearances were ſtill ſimilar. It was evident, that there was much more light in the ſhadows of the globes than in thoſe of the cylinders, not only when they were both of an equal diameter, but when that of the globe was larger than that of the cylinder, and the ſhadows of both the bodies were received at the ſame diſtance. He alſo obſerved, that he could perceive no difference of light in the ſhadows

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of the plates which were a little more than one line broad, though they were received at the distance of 72 feet; but he could observe a difference of shades in those of the globes, taken at the same distance, though they were $2\frac{1}{4}$ lines in diameter.

In order to explain the colours at the edges of these shadows, he threw some of the shadows upon others.

56 Experiments with a mixture of coloured shadows.

He threw the gleam of light, which always intervened between the colours and the darker part of the shadow, upon different parts of other shadows; and observed, that, when it fell upon the exterior penumbra made by another needle, it produced a beautiful sky-blue colour, almost like that which was produced by two blue colours thrown together. When the same gleam of light fell upon the deeper shadow in the middle, it produced a red colour.

He placed two plates of iron, each three or four lines broad, at a very small distance: and having placed them in the rays of the sun, and received their shadows at the distance of 15 or 20 feet from them, he saw no light between them but a continued shadow, in the middle of which were some parallel streaks of a lively purple, separated by other black streaks; but between them there were other streaks, both of a very faint green, and also of a pale yellow.

57 M. Mairan's theory.

The subject of inflection was next investigated by M. Mairan: but he only endeavoured to explain the facts which were known, by the hypothesis of an atmosphere surrounding all bodies; and consequently making two reflections and refractions of the light that falls upon them, one at the surface of the atmosphere, and the other at that of the body. This atmosphere he supposed to be of a variable density and refractive power, like the atmosphere.

58 Discoveries of M. Du Tour.

M. Du Tour thought the variable atmosphere superfluous, and attempted to account for all the phenomena by an atmosphere of an uniform density, and of a less refractive power than the air surrounding all bodies.

Only three fringes had been observed by preceding authors, but M. Du Tour was accidentally led to observe a greater number of them, and adopted from Grimaldi the following ingenious method of making them all appear very distinct.

Plate CCCLXXVI. fig. 9.

He took a circular board ABED, (fig. 9.) 13 inches in diameter, the surface of which was black, except at the edge, where there was a ring of white paper about three lines broad, in order to trace the circumference of a circle, divided into 360 degrees, beginning at the point A, and reckoning 180 degrees on each hand to the point E; B and D being each of them placed at 90 degrees. A slip of parchment 3 inches broad, and disposed in the form of a hoop, was fastened round the board, and pierced at the point E with a square hole, each side being 4 or 5 lines, in order to introduce a ray of the sun's light; and in the centre of the board C, he fixed a perpendicular pin about $\frac{1}{7}$ of a line in diameter.

This hoop being so placed, that a ray of light entering the chamber, through a vertical cleft of $2\frac{1}{2}$ lines in length, and about as wide as the diameter of the pin, went through the hole at E, and passing parallel to the plane of the board, projected the image of the sun and the shadow of the pin at A. In these circumstances he observed, 1. That quite round the concave surface of this hoop, there were a multitude of coloured streaks; but that the space *m* A *n*, of about 18 degrees, the middle of which was occupied by the image of the sun, was covered with a faint light only. 2. The order of the colours in these streaks was generally such that the most refrangible rays were the nearest to the incident ray ECA; so that, beginning from the point A, the violet was the first and the red the last colour in each of the streaks. In some of them, however, the colours were disposed in a contrary order. 3. The image of the sun, projected on each side of the point A, was divided by the shadow of the pin, which was bordered by two luminous streaks. 4. The coloured streaks were narrower in some parts of the hoop than others, and generally decreased in breadth in receding from the point A. 5. Among these coloured streaks, there were sometimes others which were white, 1 or $1\frac{1}{2}$ lines in breadth, which were generally bordered on both sides by a streak of orange colour.

From this experiment he thought it evident, that the rays which passed beyond the pin were not the only ones that were decomposed, for that those which were reflected from the pin were decomposed also; whence he concluded that they must have undergone some refraction. He also imagined that those which went beyond the pin suffered a reflection, so that they were all affected in a similar manner.

59 Account of Du Tour's hypothesis. Fig. 10.

In order to give some idea of his hypothesis, M. Du Tour shows that the ray *a b*, fig. 10. after being refracted at *b*, reflected at *r* and *u*, and again refracted at *s* and *t*, will be divided into its proper colours; the least refrangible or the red rays issuing at *x*, and the most refrangible or violet at *y*. Those streaks in which the colours appear in a contrary order he thinks are to be ascribed to inequalities in the surface of the pin.

The coloured streaks nearest the shadow of the pin, he supposes to be formed by those rays which, entering the atmosphere, do not fall upon the pin; and, without any reflection, are only refracted at their entering and leaving the atmosphere, as at *b* and *r u*, fig. 11. In this case, the red or least refrangible rays will issue at *r*, and the violet at *u*. Fig. 11.

To distinguish the rays which fell upon the hoop in any particular direction, from those that came in any other, he made an opening in the hoop, as at P, fig. 9. by which means he could, with advantage, and at any distance from the centre, observe those rays unmixed with any other.

To account for the coloured streaks being larger next the shadow of the pin, and growing narrower to the place where the light was admitted, he shows, by fig. 12. that the rays *a b* are farther separated by both the refractions than the rays *c d*. Fig. 12.

Sometimes M. Du Tour observed, that the broader streaks were not disposed in this regular order; but then he found, that by turning the pin they changed their places, so that this circumstance must have been an accidental irregularity in the surface of the pin.

The white streaks mixed with the coloured ones he ascribes to small cavities in the surface of the pin; for they also changed their places when the pin was turned upon its axis.

He also found, that bodies of various kinds, and of different sizes, always produced fringes of the same dimensions.

Exposing two pieces of paper in the beam of light, so that part of it passed between two planes formed by them,

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them, M. Du Tour obferved, that the edges of this light were bordered with two orange ftreaks. To account for them, he fuppofes, that the more refrangible of the rays which enter at *b* are fo refracted, that they do not reach the furface of the body at R: fo that the red and orange light may be reflected from thence in the direction *d* M, where the orange ftreaks will be formed; and, for the fame reafon, another ftreak of orange will be formed at *m*, by the rays which enter the atmofphere on the other fide of the chink. In a fimilar manner he accounts for the orange fringes at the borders of the white ftreaks, in the experiment of the hoop. He fuppofes, that the blue rays, which are not reflected at R, pafs on to I; and that thefe rays form the blue tinge obfervable in the fhadows of fome bodies. This, however, is mere trifling.

Fig. 13.

60 This hypothefis ufelefs and ill-founded.

We may here make a general obfervation, applicable to all the attempts of philofophers to explain thefe phenomena by atmofpheres. Thefe attempts give no explanation whatever of the phyfical caufe of the phenomena. A phenomenon is fome individual fact or event in nature. We are faid to explain it, when we point out the general fact in which it is comprehended, and fhow the manner in which it is fo comprehended, or the particular modification of the general fact. Philofophy refembles natural hiftory, having for its fubject the *events* of nature; and its inveftigations are nothing but the claffification of thefe events, or the arrangement of them under the general facts of which they are individual inftances. In the prefent inftance there is no general fact referred to. The atmofphere is a mere gratuitous fuppofition; and all that is done is to fhow a refemblance between the phenomena of inflection of light to what would be the phenomena were bodies furrounded with fuch atmofpheres; and even in this point of view, the difcuffions of Mairan and Du Tour are extremely deficient. They have been fatisfied with very vague refemblances to a fact obferved in one fingle inftance, and not fufficiently examined or defcribed in that inftance, namely, the refraction of light through the atmofphere of this globe.

The attempt is to explain how light is turned out of its direction by paffing near the furface of bodies. This indicates the action of forces in a direction tranfverfe to that of the light. Newton took the right road of inveftigation, by taking the phenomenon in its original fimplicity, and attending merely to this, that the rays are deflected from their former courfe; and the fole aim of his inveftigation was to difcover the laws, or the more general facts in this deflection. He deduced from the phenomena, that fome rays are more deflected than others, and endeavoured to determine in what rays the deflections are moft remarkable: and no experiment of M. Du Tour has fhown that he was miftaken in his modified affertion, that thofe rays are moft inflected which pafs neareft to the body. We fay modified affertion; for Newton points out with great fagacity many inftances of alternate fits of inflection and deflection; and takes it for granted, that the law of continuity is obferved in thefe phenomena, and that the change of inflection into deflection is gradual.

But thefe analogical difcuffions are eminently deficient in another refpect: They are held out as mechanical explanations of the changes of motion obferved in rays of light. When it fhall be fhown, that thefe are precifely fuch as are obferved in refracting atmofpheres, nothing is done towards deciding the original queftion; for the action of refracting atmofpheres prefents it in all its difficulties, and we muft ftill afk how do thefe atmofpheres produce this effect? No advance whatever is gained in fcience by thrufting in this hypothetical atmofphere; and Newton did wifely in attaching himfelf to the fimple fact: and he thus gives us another ftep in fcience, by fhowing us a fact unknown before, viz. that the action of bodies on light is not confined to tranfparent bodies. He added another general fact to our former ftock, *that light as well as other matter is acted on at a diftance*; and thus he made a very important deduction, *that reflection, refraction, and inflection, are probably brought about by the fame forces.*

61 Reflection, refraction, and inflection probably produced by the fame forces.

62 Objects fometimes magnified by inflection.

M. Le Cat has well explained a phenomenon of vifion depending upon the inflection of light, which fhows, that, in fome cafes objects by this means appear magnified. Looking at a diftant fteeple, when a wire, of a lefs diameter than the pupil of his eye, was held near to it, and drawing it feveral times betwixt his eye and that object, he found, that, every time the wire paffed before his pupil, the fteeple feemed to change its place, and fome hills beyond the fteeple appeared to have the fame motion, juft as if a lens had been drawn betwixt his eye and them. He found alfo, that there was a pofition of the wire in which the fteeple feemed not to have any motion, when the wire was paffed before his eye; and in this cafe the fteeple appeared lefs diftinct and magnified. He then placed his eye in fuch a manner with refpect to the fteeple, that the rays of light by which he faw it muft come very clofe to the edge of a window, where he had placed himfelf to make his obfervations; and paffing the wire before his eye, he obferved, that, when it was in the vifual axis, the fteeple appeared nearer to the window, on whichever fide the wire was made to approach. He repeated this experiment, and always, with the fame refult, the object being by this means magnified, and nearly doubled.

This phenomenon he explains by fig. 14. in which B reprefents the eye, A the fteeple, and C a fection of the wire. The black lines exprefs the cone of light by which the natural image of the fteeple A is formed, and which is much narrower than the diameter of the wire C; but the dotted lines include not only that cone of light, ftopped and turned out of its courfe by the wire, but alfo more diftant rays inflected by the wire, and thereby thrown more converging into the pupil; juft as would have been the effect of the interpofition of a lens between the eye and the object.

Plate CCCLXXVI fig. 14.

Sect. IV. *Difcoveries concerning Vifion.*

63 Difcoveries of Maurolycus, Kepler, &c. concerning vifion.

Maurolycus was the firft who demonftrated that the cryftalline humour of the eye is a lens which collects the light iffuing from external objects, and converges them upon the retina. He did not, however, feem to be aware that an image of every vifible object was thus formed upon the retina, though this feems hardly to have been a ftep beyond the difcovery he had made. Montucla conjectures, that he was prevented from mentioning this part of the difcovery by the difficulty of accounting for the upright appearance of objects. This difcovery was made by Kepler; but he, too, was much puzzled with the inverfion of the image upon the retina.

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na. The rectification of theſe images, he ſays, is the buſineſs of the mind; which, when it perceives an impreſſion on the lower part of the retina, conſiders it as made by rays proceeding from the higher parts of objects; tracing the rays back to the pupil, where they croſs one another. This is the true explanation of the difficulty, and is exactly the ſame as that which was lately given by Dr Reid.

64 Diſcoveries of Scheiner.

Theſe diſcoveries concerning viſion were completed by Scheiner. For, in cutting away the coats of the back part of the eyes of ſheep and oxen, and preſenting ſeveral objects before them, he ſaw their images diſtinctly painted upon the retina. He did the ſame with the human eye, and exhibited this experiment at Rome in 1625.

Scheiner took a good deal of pains to aſcertain the denſity and refractive power of all the humours of the eye, by comparing their magnifying power with that of water or glaſs in the ſame form and circumſtances. The reſult of his inquiries was, that the aqueous humour does not differ much from water in this reſpect, nor the cryſtalline from glaſs; and that the vitreous humour is a medium between both. He alſo traces the progreſs of the rays of light through all the humours; and after diſcuſſing every poſſible hypotheſis concerning the ſeat of viſion, he demonſtrates that it is in the retina, and ſhows that this was the opinion of Alhazen, Vitellio, Kepler, and all the moſt eminent philoſophers. He advances many reaſons for this hypotheſis; anſwers many objections to it; and, by a variety of arguments, refutes the opinion that the ſeat of viſion is in the cryſtalline lens.

65 Diſcoveries of Deſcartes.

The ſubject of viſion occupied the attention of Deſcartes. He explains the methods of judging of the magnitudes, ſituations, and diſtances, of objects, by the direction of the optic axes; comparing it to a blind man's judging of the ſize and diſtance of an object, by feeling it with two ſticks of a known length, when the hands in which he holds them are at a known diſtance from each other. He alſo remarks, that having been accuſtomed to judge of the ſituation of objects by their images falling on a particular part of the eye; if by any diſtortion of the eye they fall on a different place, we are apt to miſtake their ſituation, or imagine one object to be two, in the ſame way as we imagine one ſtick to be two, when it is placed between two contiguous fingers laid acroſs one another. The direction of the optic axes, he ſays, will not ſerve us beyond 15 or 20 feet, and the change of form of the cryſtalline not more than three or four feet. For he imagined that the eye conforms itſelf to different diſtances by a change in the curvature of the cryſtalline, which he ſuppoſed to be a muſcle, the tendons of it being the ciliary proceſſes. In another place, he ſays, that the change in the conformation of the eye is of no uſe to us for the purpoſe of judging of diſtances beyond four or five feet, and the angle of the optic axes not more than 100 or 200 feet: for this reaſon, he ſays, that the ſun and moon are conceived to be much more nearly of the ſame ſize than they are in reality. White and luminous objects, he obſerves, appear larger than others, and alſo the parts contiguous to thoſe on which the rays actually impinge; and for the ſame reaſon, if the objects be ſmall, and placed at a great diſtance, they will always appear round, the figure of the angles diſappearing.

The celebrated Dr Berkeley, biſhop of Cloyne, publiſhed, in 1709, An Eſſay towards a New Theory of Viſion, in which he ſolves many difficulties. He does not admit that it is by means of thoſe lines and angles, which are uſeful in explaining the theory of optics, that different diſtances are eſtimated by the ſenſe of ſight; neither does he think that the mere direction of the optic axes or the greater or leſs divergency of the rays of light are ſufficient for this purpoſe. "I appeal (ſays he) to experience, whether any one computes its diſtance by the bigneſs of the angle made by the meeting of the two *optic axes*; or whether he ever thinks of the greater or leſs divergency of the rays which arrive from any point to his pupil: Nay, whether it be not perfectly impoſſible for him to perceive, by ſenſe, the various angles wherewith the rays according to their greater or leſſer divergency fell upon his eye." That there is a neceſſary connexion between theſe various angles, &c. and different degrees of diſtance, and that this connexion is known to every perſon ſkilled in optics, he readily acknowledges; but "in vain (he obſerves) ſhall mathematicians tell me, that I *perceive* certain *lines* and *angles*, which introduce into my mind the various notions of *diſtance*, ſo long as I am conſcious of no ſuch thing." He maintains that diſtance, magnitude, and even figure, are the objects of immediate perception only by the ſenſe of touch; and that when we judge of them by ſight, it is from different ſenſations felt in the eye, which experience has taught us to be the conſequence of viewing objects of greater or leſs magnitude, of different figures, and at different diſtances. Theſe ſenſations, with the reſpective diſtances, figures, and magnitudes by which they are occaſioned, become ſo cloſely aſſociated in the mind long before the period of diſtinct recollection, that the preſence of the one inſtantly ſuggeſts the other; and we attribute to the ſenſe of ſight thoſe notions which are acquired by the ſenſe of touch, and of which certain *viſual* ſenſations are merely the ſigns or ſymbols, juſt as words are the ſymbols of ideas. Upon theſe principles he accounts for ſingle and erect viſion. Subſequent writers have made conſiderable diſcoveries in the theory of viſion; and among them there is hardly any one to whom this branch of ſcience is ſo much indebted as to Dr Reid, and Dr Wells, whoſe reaſonings we ſhall afterwards have occaſion to detail.

66 Berkeley's theory of viſion.

Sect. V. *Of Optical Inſtruments.*

67 Invention of ſpectacles.

Glass globes, and ſpecula, ſeem to have been the only optical inſtruments known to the ancients. Alhazen gave the firſt hint of the invention of ſpectacles. From the writings of this author, together with the obſervations of Roger Bacon, it is not improbable that ſome monks gradually hit upon the conſtruction of ſpectacles; to which Bacon's leſſer ſegment was a nearer approach than Alhazen's larger one.

It is certain that ſpectacles were well known in the 13th century, and not long before. It is ſaid that Alexander Spina, a native of Piſa, who died in 1313, happened to ſee a pair of ſpectacles in the hands of a perſon who would not explain them to him; but that he ſucceeded in making a pair for himſelf, and immediately made the conſtruction public. It is alſo inſcribed on the tomb of Salvinus Armatus, a nobleman of Florence, who died 1317, that he was the inventor of ſpectacles.

Though

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68 Descartes's account of the invention of telescopes.

Though both convex and concave lenses were sufficiently common, yet no attempt was made to combine them into a telescope till the end of the 16th century. Descartes considers James Metius as the first constructor of the telescope: and says, that as he was amusing himself with mirrors and burning glasses, he thought of looking through two of his lenses at a time; and that happening to take one that was convex and another that was concave, and happening also to hit upon a pretty good adjustment of them, he found, that, by looking through them, distant objects appeared very large and distinct. In fact, without knowing it, he had made a telescope.

69 Other accounts.

Other persons say, that this great discovery was first made by John Lippersheim, a spectacle-maker at Middleburgh, or rather by his children; who were diverting themselves with looking through two glasses at a time, and placing them at different distances from one another. But Borellus, the author of a book entitled *De vero telescopii inventore*, gives this honour to Zacharias Joannides, i. e. Jansen, another spectacle-maker at the same place, who made the first telescope in 1590.

This ingenious mechanic had no sooner found the arrangement of glasses that magnified distant objects, than he enclosed them in a tube, and ran with his instrument to Prince Maurice; who, immediately conceiving that it might be useful in his wars, desired the author to keep it a secret. But this was found impossible; and several persons in that city immediately applied themselves to the making and selling of telescopes. One of the most distinguished of these was Hans Laprey, called *Lippersheim* by Sirturus. Some person in Holland being very early supplied by him with a telescope, he passed with many for the inventor; but both Metius above mentioned, and Cornelius Drebell of Alcmaar, in Holland, applied to the inventor himself in 1620; as also did Galileo, and many others. The first telescope made by Jansen did not exceed 15 or 16 inches in length; but Sirturus, who says that he had seen it, and made use of it, thought it the best that he had ever examined.

70 The first telescope an exceedingly good one.

Jansen directing his telescope to celestial objects, distinctly viewed the spots on the surface of the moon; and discovered many new stars, particularly seven pretty considerable ones in the Great Bear. His son, Joannes Zacharias, observed the lucid circle near the limb of the moon, from whence several bright rays seem to dart in different directions: and he says, that the full moon, viewed through this instrument, did not appear flat, but was evidently globular. Jupiter appeared round, and rather spherical; and sometimes he perceived two, sometimes three, and at other times even four small stars, a little above or below him; and, as far as he could observe, they performed revolutions round him.

71 A telescope made by Galileo without seeing one.

There are some who say that Galileo was the inventor of telescopes; but he himself acknowledges, that he first heard of the instrument from a German; but, that being informed of nothing more than the effects of it, first by common report, and a few days after by a French nobleman, J. Badovere, at Paris, he himself discovered the construction, by considering the nature of refraction: and thus he had much more real merit than the inventor himself.

About April or May, in 1609, it was reported at Venice, where Galileo (who was professor of mathematics in the university of Padua) then happened to be, that a Dutchman had presented to Count Maurice of Nassau, a certain optical instrument, by means of which, distant objects appeared as if they were near; but no farther account of the discovery had reached that place, though this was near 20 years after the first discovery of the telescope. Struck, however, with this account, Galileo returned to Padua, considering what kind of an instrument this must be. The night following, the construction occurred to him; and the day after, putting the parts of the instrument together, as he had previously conceived it; and notwithstanding the imperfection of the glasses that he could then procure, the effect answered his expectations, as he presently acquainted his friends at Venice, where, from several eminences, he showed to some of the principal senators of that republic a variety of distant objects, to their very great astonishment. When he had made farther improvements in the instrument, he made a present of one of them to the Doge, Leonardo Donati, and at the same time to all the senate of Venice; giving along with it a written paper, in which he explained the structure and wonderful uses that might be made of the instrument both by land and sea. In return for so noble an entertainment, the republic, on the 25th of August, in the same year, more than tripled his salary as professor.

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72 Account of his discoveries.

Galileo having amused himself for some time with the view of terrestrial objects, at length directed his tube towards the heavens; and found, that the surface of the moon was diversified with hills and valleys, like the earth. He found that the milky way and *nebulæ* consisted of a collection of fixed stars, which, on account either of their vast distance, or extreme smallness, were invisible to the naked eye. He also discovered innumerable fixed stars dispersed over the face of the heavens, which had been unknown to the ancients; and examining Jupiter, he found him attended by four stars, which, at certain periods, performed revolutions round him.

This discovery he made in January 1610, new style; and continuing his observations the whole of February following, he published, in the beginning of March, an account of all his discoveries, in his *Nuncius Sidereus*, printed at Venice.

The extraordinary discoveries contained in the Nuncius Sidereus, which was immediately reprinted both in Germany and France, were the cause of much debate among the philosophers of that time; many of whom could not give any credit to Galileo's account, while others endeavoured to decry his discoveries as nothing more than mere illusions.

In the beginning of July, 1610, Galileo being still at Padua, and getting an imperfect view of Saturn's ring, imagined that that planet consisted of three parts; and therefore, in the account which he gave of this discovery to his friends, he calls it *planetam tergeminam*.

Whilst he was still at Padua, he observed some spots on the face of the sun: but he did not choose, at that time, to publish his discovery; partly for fear of incurring more of the hatred of many obstinate Peripatetics; and partly in order to make more exact observations on this remarkable phenomenon, as well as to form some conjecture concerning the probable cause of it. He therefore contented himself with communicating his observations to some of his friends at Padua and Venice,

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among whom we find the name of Father Paul. This delay, however, was the cause of this discovery being contested with him by the famous Scheiner, who likewise made the same observation in October 1611, and we suppose had anticipated Galileo in the publication of it.

In November following Galileo was satisfied, that, from the September preceding, Venus had been continually increasing in bulk, and that she changed her phases like the moon. About the end of March 1611, he went to Rome, where he gratified the cardinals, and all the principal nobility, with a view of the new wonders which he had discovered in the heavens.

Twenty-nine years Galileo enjoyed the use of his telescope, continually enriching astronomy with his observations: but by too close an application to that instrument, and the detriment he received from the nocturnal air, his eyes grew gradually weaker, till in 1639 he became totally blind; a calamity which, however, neither broke his spirits, nor interrupted the course of his studies.

73 Account of his telescopes.

The first telescope that Galileo constructed magnified only three times; but presently after, he made another which magnified 18 times; and afterwards, with great trouble and expence, he constructed one that magnified 33 times; and with this it was that he discovered the satellites of Jupiter and the spots of the sun.

74 The *rationale* of the instrument first discovered by Kepler.

The honour of explaining the rationale of the telescope is due to the celebrated Kepler. He made several discoveries relating to the nature of vision; and not only explained the theory of the telescope which he found in use, but also pointed out methods of constructing others of superior powers and more commodious application.

It was Kepler who first gave a clear explication of the effects of lenses, in converging and diverging the rays of a pencil of light. He showed, that a plano-convex lens makes rays that were parallel to its axis, to meet at the distance of the diameter of the sphere of convexity; but that if both sides of the lens be equally convex, the rays will have their focus at the distance of the radius of the circle, corresponding to that degree of convexity. He did not, however, investigate any rule for the foci of lenses unequally convex. He only says, in general, that they will fall somewhere in the middle, between the foci belonging to the two different degrees of convexity. We owe this investigation to Cavalieri, who laid down the following rule: As the sum of both the diameters is to one of them, so is the other to the distance of the focus.

75 General reason of the effects of telescopes.

The principal effects of telescopes depend upon these simple principles, viz. That objects appear larger in proportion to the angles which they subtend at the eye; and the effect is the same whether the pencils of rays, by which objects are visible to us, come directly from the objects themselves, or from any place nearer to the eye, where they may have been converged so as to form an image of the object; because they issue again from those points where there is no real substance, in certain directions, in the same manner as they did from the corresponding points in the objects themselves.

In fact, therefore, all that is effected by a telescope is, first, to make such an image of a distant object, by means of a lens or mirror; and then to give the eye some assistance for viewing that image as near as possible: so that the angle which it shall subtend at the eye, may be very large, compared with the angle which the object itself would subtend in the same situation. This is done by means of an eye-glass, which so refracts the pencils of rays, that they may afterwards be brought to their several foci by the humours of the eye. But if the eye was so formed as to be able to see the image with sufficient distinctness at the same distance without any eye-glass, it would appear to him as much magnified as it does to another person who makes use of a glass for that purpose, though he would not in all cases have so large a field of view.

If, instead of an eye-glass, an object be looked at through a small hole in a thin plate or piece of paper, held close to the eye, it may be viewed very near to the eye, and, at the same distance, the apparent magnitude of the object will be the same in both cases. For if the hole be so small as to admit but a single ray from every point of the object, these rays will fall upon the retina in as many other points, and make a distinct image. They are only pencils of rays, which have a sensible base, as the breadth of the pupil, that are capable, by their spreading on the retina, of producing an indistinct image. As very few rays, however, can be admitted through a small hole, there will seldom be light sufficient to view any object to advantage in this manner.

If no image be formed by the foci of the pencils without the eye, yet if, by the help of a concave eye-glass, the pencils of rays shall enter the pupil, just as they would have done from any place without the eye, the visual angle will be the same as if an image had actually been formed in that place. Objects will not appear inverted through this telescope, because the pencils which form the images of them, only cross one another once, viz. at the object glass, as in natural vision they do in the pupil of the eye.

Such is the telescope that was first discovered and used by philosophers. The great inconvenience attending it is, that the field of view is exceedingly small. For since the pencils of rays enter the eye very much diverging from one another, but few of them can be intercepted by the pupil. This inconvenience increases with the magnifying power of the telescope; so that it is a matter of surprise how, with such an instrument, Galileo and others could have made such discoveries. No other telescope, however, than this, was so much as thought of for many years after the discovery. Descartes, who wrote 30 years after, mentions no others as actually constructed.

76 Galilean telescope more difficult of construction than others.

It is to the celebrated Kepler that we are indebted for the construction of what we now call the *astronomical telescope*. The *rationale* of this instrument is explained, and the advantages of it are clearly pointed out, by this philosopher, in his Catoptrics; but, what is very surprising, he never actually reduced his theory into practice. Montucla conjectures, that the reason why he did not make trial of this new construction was, his not being aware of the great increase of the field of view; so that being engaged in other pursuits, he might not think it of much consequence to take any pains about the construction of an instrument, which could do little more than answer the same purpose with those which he already possessed. He must also have foreseen, that the length

77 Telescopes improved by Kepler.

History. length of this teleſcope muſt have been greater in proportion to its magnifying power, ſo that it might appear to him to be upon the whole not quite ſo good a conſtruction as the former.

78 His method firſt put in practice by Scheiner. The firſt perſon who actually made an inſtrument of Kepler's conſtruction was Father Scheiner, who has given a deſcription of it in his *Roſa Urſina*, publiſhed in 1630. If, ſays he, you inſert two ſimilar lenſes in a tube, and place your eye at a convenient diſtance, you will ſee all terreſtrial objects inverted, indeed, but magnified and very diſtinct, with a conſiderable extent of view. He afterwards ſubjoins an account of a teleſcope of a different conſtruction, with two convex eye glaſſes, which again reverſes the images, and makes them appear in their natural poſition. This diſpoſition of the lenſes had alſo been pointed out by Kepler, but had not been reduced to practice. This conſtruction, however, anſwered the end very imperfectly; and Father Rheita preſently after diſcovered a better conſtruction, uſing three eye glaſſes inſtead of two.

The only difference between the Galilean and the aſtronomical teleſcope is, that the pencils by which the extremities of any object are ſeen in this caſe, enter the eye diverging; whereas, in the other, they enter it converging; but if the ſphere of concavity in the eye-glaſs of the Galilean teleſcope be equal to the ſphere of convexity in the eye-glaſs of another teleſcope, their magnifying power will be the ſame. The concave eye-glaſs, however, being placed between the object-glaſs and its focus, the Galilean teleſcope will be ſhorter than the other, by twice the focal length of the eye-glaſs. Conſequently, if the length of the teleſcopes be the ſame, the Galilean will have the greater magnifying power.

79 Huygens improves the teleſcopes of Scheiner and Rheita. Huygens was particularly eminent for his ſyſtematic knowledge of optics, and is the author of the chief improvements which have been made on all the dioptrical inſtruments till the diſcovery of the achromatic teleſcope. He was well acquainted with the theory of aberration ariſing from the ſpherical figure of the glaſſes, and has ſhown ſeveral ingenious methods of diminiſhing them by proper conſtructions of the eye-pieces. He firſt pointed out the advantages of two eye-glaſſes in the aſtronomical teleſcope and double microſcope, and gave rules for this conſtruction, which both enlarges the field and ſhortens the inſtrument. Mr Dollond adapted his conſtruction to the terreſtrial teleſcope of De Rheita; and his five eye-glaſſes are nothing but the Huygenian eye-piece doubled. This conſtruction has been too haſtily given up by the artiſts of the preſent day for another, alſo of Mr Dollond's, of four glaſſes.

80 Binocular teleſcope. The ſame Father Rheita, to whom we are indebted for the conſtruction of a teleſcope for land objects, invented a binocular teleſcope, which Father Cherubin, of Orleans, afterwards endeavoured to bring into uſe. It conſiſts of two teleſcopes faſtened together, pointed to the ſame object. When this inſtrument is well fixed, the object appears larger, and nearer to the eye, when it is ſeen through both the teleſcopes, than through one of them only, though they have the very ſame magnifying power. But this is only an illuſion, occaſioned by the ſtronger impreſſion made upon the eye, by two equal images, equally illuminated. This advantage, however, is counterbalanced by the inconvenience attending the uſe of it.

The firſt who diſtinguiſhed themſelves in grinding teleſcopic glaſſes were two Italians, Euſtachio Divini at Rome, and Campani at Bologna, whoſe fame was much ſuperior to that of Divini, or that of any other perſon of his time; though Divini himſelf pretended, that, in all the trials that were made with their glaſſes, his, of a great focal length, performed better than thoſe of Campani, and that his rival was not willing to try them with equal eye-glaſſes. It is generally ſuppoſed, however, that Campani really excelled Divini, both in the goodneſs and the focal length of his object-glaſſes. It was with teleſcopes made by Campani that Caſſini diſcovered the neareſt ſatellites of Saturn. They were made by the expreſs order of Louis XIV. and were of 86, 100, and 136 Paris feet in focal length. History. 81 Teleſcopes of Campani and Divini.

Campani ſold his lenſes for a great price, and took every poſſible method to keep his art of making them ſecret. His laboratory was inacceſſible, till after his death; when it was purchaſed by Pope Benedict XIV. who preſented it to the academy called the *Inſtitute*, eſtabliſhed in that city; and by the account which M. Fougeroux has given of what he could diſcover from it, we learn, that (except a machine, which M. Campani conſtructed, to work the baſons on which he ground his glaſſes) the goodneſs of his lenſes depended upon the clearneſs of his glaſs, his Venetian tripoli, the paper with which he poliſhed them, and his great ſkill and addreſs as a workman. It was alſo the general opinion that he owed much of his reputation to the ſecrecy and air of myſtery which he affected; and that he made a great number of object-glaſſes which he rejected, ſhowing only thoſe that were very good. He made few lenſes of a very great focal diſtance; and having the misfortune to break one of 141 feet in two pieces, he took incredible pains to join the two parts together, which he did at length ſo effectually, that it was uſed as if it had been entire; but it is not probable that he would have taken ſo much pains about it, if, as he pretended, he could very eaſily have made another as good.

Sir Paul Neille, Dr Hooke ſays, made teleſcopes of of 36 feet, pretty good, and one of 50, but not of proportional goodneſs. Afterwards Mr Reive, and then Mr Cox, who were the moſt celebrated in England as grinders of optic glaſſes, made ſome good inſtruments of 50 and 60 feet focal length, and Mr Cox made one of 100.

These, and all other teleſcopes, were far exceeded by an object-glaſs of 600 feet focus made by M. Auzout; but he was never able to manage it. Hartſocker is even ſaid to have made ſome of a ſtill greater focal length; but this ingenious mechanic, finding it impoſſible to make uſe of object-glaſſes the focal diſtance of which was much leſs than this, when they were encloſed in a tube, contrived a method of uſing them without a tube, by fixing them at the top of a tree, a high wall, or the roof of a houſe. 82 Extraordinary object glaſs made by M. Auzout.

Mr Huygens, who was alſo an excellent mechanic, made conſiderable improvements on this contrivance of Hartſocker's. He placed the object-glaſs at the top of a long pole, having previouſly encloſed it in a ſhort tube, which was made to turn in all directions by means of a ball and ſocket. The axis of this tube he could command with a fine ſilken ſtring, ſo as to bring it into a line with the axis of another ſhort tube which he held in his hand, and which contained the eye-glaſs. In this method he could make uſe of object-glaſſes of the greateſt magnifying 83 Teleſcopes uſed without tubes.

fying power, at whatever altitude his object was, and even in the zenith, provided his pole was as long as his teleſcope; and to adapt it to the view of objects of different altitudes, he had a contrivance, by which he could raiſe or depreſs at pleaſure, a ſtage that ſupported his object-glaſs.

M. de la Hire, made ſome improvement in this method of managing the object-glaſs, by fixing it in the centre of a board, and not in a tube; but as it is not probable that this method will ever be made uſe of, ſince the diſcovery of both reflecting and achromatic teleſcopes, which are now brought to great perfection, and have even micrometers adapted to them, we ſhall not deſcribe the apparatus minutely; but ſhall only give a drawing of M. Huygen's pole, with a ſhort explanation. In fig 1. *a* repreſents a pulley, by the help of which a ſtage *c*, *d*, *e*, *f*, (that ſupports the object-glaſs *k*, and the apparatus belonging to it), may be raiſed higher or lower at pleaſure, the whole being counterpoiſed by the weight *h*, faſtened to a ſtring *g*. *n*, is a weight, by means of which the centre of gravity of the apparatus belonging to the object-glaſs is kept in the ball and ſocket, ſo that it may be eaſily managed by the ſtring *l u*, and its axis brought into a line with the eye-glaſs at *o*. When it was very dark, M. Huygens was obliged to make his object-glaſs viſible by a lantern, *y*, ſo conſtructed as to throw up to it the rays of light in a parallel direction.

Plate CCCLXXVII. fig. 1.

84
Of the apertures of refracting teleſcopes.

Before leaving this ſubject, it muſt be obſerved, that M. Auzout, in a paper delivered to the Royal Society, obſerved, that the apertures which the object-glaſſes of refracting teleſcopes can bear with diſtinctneſs, are in the ſub-duplicate ratio of their lengths; and upon this ſuppoſition he drew up a table of the apertures of object-glaſſes of a great variety of focal lengths, from 4 inches to 400 feet. Upon this occaſion, however, Dr Hooke obſerved, that the ſame glaſs will bear a greater or leſs aperture, according to the leſs or greater light of the object.

But all theſe improvements were diminiſhed in value by the diſcovery of the *reflecting teleſcope*. For a refracting teleſcope, even of 1000 feet focus, ſuppoſing it poſſible to be made uſe of, could not be made to magnify with diſtinctneſs more than 1000 times; whereas a reflecting teleſcope, not exceeding 9 or 10 feet will magnify 1200 times.

85
Hiſtory of the reflecting teleſcope.

"It muſt be acknowledged, ſays Dr Smith, that Mr James Gregory of Aberdeen was the firſt inventor of the reflecting teleſcope; but his conſtruction is quite different from Sir Iſaac Newton's, and not nearly ſo advantageous."

According to Dr Pringle, Merſennus was the man who entertained the firſt thought of a reflector. He certainly propoſed a teleſcope with ſpecula to the celebrated Deſcartes many years before Gregory's invention, though indeed in a manner ſo very unſatisfactory, that Deſcartes was ſo far from approving the propoſal, that he endeavoured to convince Merſennus of its fallacy. Dr Smith, it appears, had never peruſed the two letters of Deſcartes to Merſennus which relate to that ſubject.

Gregory, a young man of uncommon genius, was led to the invention, in trying to correct two imperfections of the common teleſcope: the firſt was its too great length, which made it leſs manageable; the ſecond, the incorrectneſs of the image. Mathematicians had demonſtrated, that a pencil of rays could not be collected in a ſingle point by a ſpherical lens; and alſo, that the image tranſmitted by ſuch a lens would be in ſome degree incurvated. Theſe inconveniences he believed would be obviated by ſubſtituting for the object-glaſs a metallic ſpeculum, of a parabolic figure, to receive the incident rays, and to reflect them towards a ſmall ſpeculum of the ſame metal; this again was to return the image to an eye-glaſs placed behind the great ſpeculum, which for that purpoſe was to be perforated in its centre. This conſtruction he publiſhed in 1663, in his *Optica Promota*. But as Gregory, by his own account, was endowed with no mechanical dexterity, nor could find any workman capable of conſtructing his inſtrument, he was obliged to give up the purſuit: and probably, had not ſome new diſcoveries been made in light and colours, a reflecting teleſcope would never more have been thought of.

At an early period of life, Newton had applied himſelf to the improvement of the teleſcope; but imagining that Gregory's ſpecula were neither very neceſſary, nor likely to be executed, he began with proſecuting the views of Deſcartes, who aimed at making a more perfect image of an object, by grinding lenſes, not to the figure of a ſphere, but to that of one of the conic ſections. Whilſt he was thus employed, three years after Gregory's publication, he happened to examine the colours, formed by a priſm, and having by means of that ſimple inſtrument diſcovered the different refrangibility of the rays of light, he then perceived that the errors of teleſcopes ariſing from that cauſe alone, were ſome hundred times greater than thoſe which were occaſioned by the ſpherical figure of lenſes. This circumſtance forced, as it were, Newton to fall into Gregory's track, and to turn his thoughts to reflectors. "The different refrangibility of the rays of light (ſays he in a letter to Mr Oldenburg, ſecretary to the Royal Society, dated Feb. 1672) made me take reflections into conſideration; and finding them regular, ſo that the angle of reflection of all ſorts of rays was equal to the angle of incidence, I underſtood that by their mediation optic inſtruments might be brought to any degree of perfection imaginable, providing a reflecting ſubſtance could be found which would poliſh as finely as glaſs, and reflect as much light as glaſs tranſmits, and the art of communicating to it a parabolic figure he alſo obtained. Amidſt theſe thoughts I was forced from Cambridge by the intervening plague, and it was more than two years before I proceeded further."

It was towards the end of 1668, or in the beginning of the following year, when Newton being obliged to have recourſe to reflectors, and not relying on any artificer for making his ſpecula, ſet about the work himſelf, and early in the year 1672 completed two ſmall reflecting teleſcopes. In theſe he ground the great ſpeculum into the concave portion of a ſphere; not but that he approved of the parabolic form propoſed by Gregory, though he found himſelf unable to accompliſh it. In the letter that accompanied one of theſe inſtruments which he preſented to the Society, he writes, "that though he then deſpaired of performing that work (to wit, the parabolic figure of the great ſpeculum) by geometrical rules, yet he doubted not but that the thing might in ſome meaſure be accompliſhed by mechanical devices."

Not leſs did the difficulty appear to find a metallic

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substance that would be of a proper hardness, have the fewest pores, and receive the smoothest polish; a difficulty which he deemed almost unsurmountable, when he considered, that every irregularity in a reflecting surface would make the rays of light stray five or six times more out of their due course, than similar irregularities in a refracting one. In another letter, written soon after, he informs the secretary, "that he was very sensible that metal reflects less light than glass transmits; but as he had found some metallic substances more strongly reflective than others, to polish better, and to be freer from tarnishing than others, so he hoped that there might in time be found out some substances much freer from these inconveniencies than any yet known." Newton therefore laboured till he found a composition that answered in some degree, and left it to those who should come after him to find a better. Huygens, one of the greatest geniuses of the age, and a distinguished improver of the refracting telescope, no sooner was informed by Mr Oldenburg of the discovery, than he wrote in answer, "that it was an admirable telescope; and that Mr Newton had well considered the advantage which a concave speculum had over convex glasses in collecting the parallel rays, which, according to his own calculation, was very great: Hence that Mr Newton could give a far greater aperture to that speculum than to an object glass of the same focal length, and consequently produce a much greater magnifying power than by an ordinary telescope: Besides, that by the reflector he avoided an inconvenience inseparable from object glasses, which was the obliquity of both their surfaces, which vitiated the refraction of the rays that pass towards the side of the glass: Again, That by the mere reflection of the metalline speculum there were not so many rays lost as in glasses, which reflected a considerable quantity by each of their surfaces, and besides intercepted many of them by the obscurity of their substance: That the main business would be, to find a substance for this speculum that would bear as good a polish as glass. Lastly, He believed that Mr Newton had not omitted to consider the advantage which a parabolic speculum would have over a spherical one in this construction; but had despaired, as he himself had done, of working other surfaces than spherical ones with exactness." Huygens was not satisfied with thus expressing to the society his high approbation of the invention; but drew up a favourable account of the new telescope, which he published in the *Journal des Sçavans* for 1672, by which channel it was soon known over Europe.

Excepting an unsuccessful attempt which the society made, by employing an artificer to imitate the Newtonian construction, but upon a larger scale, and a disguised Gregorian telescope, set up by Cassegrain abroad as a rival to Newton's, no reflector was heard of for nearly half a century after. But when that period was elapsed, a reflecting telescope of the Newtonian form was at last produced by Mr Hadley, the inventor of the reflecting quadrant. The two telescopes which Newton had made were but six inches long; they were held in the hand for viewing objects, and in power were compared to a six feet refractor; whereas Hadley's was about five feet long, was provided with a well-contrived aparatus for managing it, and equalled in performance the famous aërial telescope of Huygens of 123 feet in length. Excepting the manner of making the specula, we have, in the Philosophical Transactions of 1723, a complete description, with a figure of this telescope, together with that of the machine for moving it; but, by a strange omission, Newton's name is not once mentioned in that paper, so that any person not acquainted with the history of the invention, and reading that account only, might be apt to conclude that Hadley had been the sole inventor.

The same celebrated artist, after finishing two telescopes of the Newtonian construction, accomplished a third of the Gregorian form; but, it would seem, less successfully. Mr Hadley spared no pains to instruct Mr Molyneux and the Reverend Dr Bradley; and when those gentlemen had made a sufficient proficiency in the art, being desirous that these telescopes should become more public, they liberally communicated to some of the principal instrument-makers of London the knowledge they had acquired from him.

Mr James Short, as early as the year 1734, had signalized himself at Edinburgh by the excellence of his telescopes. Mr Maclaurin wrote that year to Dr Jurin, "that Mr Short, who had begun with making glass specula, was then applying himself to improve the metallic; and that, by taking care of the figure, he was enabled to give them larger apertures that others had done; and that upon the whole they surpassed in perfection all that he had seen of other workmen." He added, "that Mr Short's telescopes were all of the Gregorian construction; and that he had much improved that excellent invention." This character of excellence Mr Short maintained to the last; and with the more facility, as he was well acquainted with the theory of optics. It was supposed that he had fallen upon a method of giving the parabolic figure to his great speculum; a point of perfection that Gregory and Newton had despaired of attaining; and that Hadley had never, as far as we know, attempted. Mr Short indeed affirmed, that he had acquired that faculty, but never would tell by what peculiar means he effected it; so that the secret of working that configuration, whatever it was, died with that ingenious artist. Mr Mudge, however, has lately realized the expectation of Sir Isaac Newton, who, above 100 years ago, presaged that the public would one day possess a parabolic speculum, not accomplished by mathematical rules, but by mechanical devices.

This was a *desideratum*, but it was not the only want supplied by this gentleman: he has taught us likewise a better composition of metals for the specula, how to grind them better, and how to give them a finer polish; and this last part (namely, the polish), he remarks, was the most difficult and essential of the whole operation. "In a word (says Sir John Pringle), I am of opinion, there is no optician in this great city (which hath been so long and so justly renowned for ingenious and dexterous makers of every kind of mathematical instruments) so partial to his own abilities as not to acknowledge, that, Mr Mudge has opened to them all some new and important lights, and has greatly improved the art of making reflecting telescopes."

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Mr Edwards's improvements of the reflecting telescope.

The late reverend and ingenious John Edwards devoted much of his time to the improvement of reflecting telescopes, and brought them to such perfection,

fection, that Dr Maſkelyne, the aſtronomer royal, found teleſcopes conſtructed by him to ſurpaſs in brightneſs, and other reſpects, thoſe of the ſame ſize made by the beſt artiſts in London. The chief excellence of his teleſcopes ariſes from the compoſition, which, from various trials on metals and ſemimetals, he diſcovered for the ſpecula, and from the true parabolic figure, which, by long practice, he had found a method of giving them, preferable to any that was known before him. His directions for the compoſition of ſpecula, and for caſting, grinding, and poliſhing them, were publiſhed, by order of the commiſſioners of longitude, at the end of the Nautical Almanack for the year 1787. To the ſame almanack is alſo annexed his account of the cauſe and cure of the tremors which particularly affect reflecting teleſcopes more than refracting ones, together with remarks on theſe tremors by Dr Maſkelyne.

87
Herſchel's improvements.

But in conſtructing reflecting teleſcopes of extraordinary magnifying powers, Dr Herſchel has diſplayed ſkill and ingenuity ſurpaſſing all his predeceſſors in this department of mechanics. He has made them from 7, 10, 20, to even 40 feet in length; and with inſtruments of theſe dimenſions he is now employed in making diſcoveries in aſtronomy. Of the conſtruction, magnifying powers, and the curious collection of machinery by which his 40 feet teleſcope is ſupported and moved from one part of the heavens to another, accounts will be given under the word TELESCOPE.

The greateſt improvement in *refracting* teleſcopes hitherto made public is that of Mr Dollond, of which an account has already been given in a preceding ſection, in which his diſcoveries in the ſcience of Optics were explained. But, beſides the obligation we are under to him for correcting the aberration of the rays of light in the focus of object-glaſſes, he made another conſiderable improvement in teleſcopes, viz. by correcting, in a great meaſure, both this kind of aberration, and alſo that which ariſes from the ſpherical form of lenſes, by an expedient of a very different nature, viz. increaſing the number of eye-glaſſes.

88
Account of Mr Dollond's improvements.

If any perſon, ſays he, would have the viſual angle of a teleſcope to contain 20 degrees, the extreme pencils of the field muſt be bent or refracted in an angle of 10 degrees; which, if it be performed by one eye-glaſs, will cauſe an aberration from the figure, in proportion to the cube of that angle; but if two glaſſes be ſo proportioned and ſituated, as that the refraction may be equally divided between them, they will each of them produce a refraction equal to half the required angle; and therefore, the aberration being proportional to the cube of half the angle taken twice over, will be but a fourth part of that which is in proportion to the cube of the whole angle; becauſe twice the cube of 1 is but $\frac{1}{4}$ of the cube of 2; ſo the aberration from the figure, where two eye-glaſſes are rightly proportioned, is but a fourth of what it muſt unavoidably be, where the whole is performed by a ſingle eye-glaſs. By the ſame way of reaſoning, when the refraction is divided between three glaſſes, the aberration will be found to be but the ninth part of what would be produced from a ſingle glaſs; becauſe three times the cube of 1 is but one-ninth of the cube of 3. Whence it appears, that by increaſing the number of eye-glaſſes, the indiſtinctneſs which is obſerved near the borders of the field of a teleſcope may be very much diminiſhed.

The method of correcting the errors ariſing from the different refrangibility of light is of a different conſideration from the former. For, whereas the errors from the figure can only be diminiſhed in a certain proportion according to the number of glaſſes, in this they may be entirely corrected by the addition of only one glaſs. Alſo in the day-teleſcope, where no more than two eye-glaſſes are abſolutely neceſſary for erecting the object, we find, that by the addition of a third, rightly ſituated, the colours, which would otherwiſe make the image confuſed, are entirely removed. This, however, is to be underſtood with ſome limitation: for though the different colours into which the extreme pencils muſt neceſſarily be divided by the edges of the eye-glaſſes, may in this manner be brought to the eye in a direction parallel to each other, ſo as to be made to converge to a point on the retina; yet, if the glaſſes exceed a certain length, the colours may be ſpread too wide to be capable of being admitted through the pupil or aperture of the eye; which is the reaſon, that in long teleſcopes, conſtructed in the common manner, with three eye-glaſſes, the field is always very much contracted.

Theſe conſiderations firſt ſet Mr Dollond on contriving how to enlarge the field, by increaſing the number of eye-glaſſes without affecting the diſtinctneſs or brightneſs of the image; and though others had been about the ſame work before, yet, obſerving that ſome five-glaſs teleſcopes which were then made would admit of farther improvement, he endeavoured to conſtruct one with the ſame number of glaſſes in a better manner; which ſo far anſwered his expectations, as to be allowed by the beſt judges to be a conſiderable improvement on the former.

Encouraged by this ſucceſs, he reſolved to try if he could not make ſome farther enlargement of the field, by the addition of another glaſs, and by placing and proportioning the glaſſes in ſuch a manner as to correct the aberrations as much as poſſible, without injuring the diſtinctneſs; and at laſt he obtained as large a field as is convenient or neceſſary, and that even in the longeſt teleſcopes that can be made.

Theſe teleſcopes with ſix glaſſes having been well received, and ſome of them being carried into foreign countries, it ſeemed a proper time to the author to ſettle the date of his invention; on which account he drew up a letter, which he addreſſed to Mr Short, and which was read at the Royal Society, March 1. 1753.

89
Equatorial teleſcope, or portable obſervatory.

To Mr Short we are indebted for the excellent contrivance of an equatorial teleſcope, or, as he likewiſe called it, a *portable obſervatory;* for with it pretty accurate obſervations may be made with very little trouble, by thoſe who have no building adapted to the purpoſe. The inſtrument conſiſts of a piece of machinery, by which a teleſcope mounted upon it may be directed to any degree of right aſcenſion or declination, ſo that the place of any of the heavenly bodies being known, they may be found without any trouble, even in the day-time. As it is made to turn parallel to the equator, any object is eaſily kept in view, or recovered, without moving the eye from its ſituation. By this inſtrument moſt of the ſtars of the firſt and ſecond magnitude have been ſeen even at mid-day, when the ſun was ſhining bright; as

History. alſo Mercury, Venus, and Jupiter. Saturn and Mars are not ſo eaſy to be ſeen, on account of the faintneſs of their light, except when the ſun is but a few hours above the horizon. This particular effect depends upon the teleſcope excluding almoſt all the light, except what comes from the object itſelf, and which might otherwiſe efface the impreſſion made by its weaker light upon the eye. Any teleſcope of the ſame magnifying power would have the ſame effect, could we be ſure of pointing it right. Mr Ramſden invented a *portable* or *equatorial teleſcope*, which may perhaps ſuperſede the uſe of Mr Short's.

90 How to obſerve the ſtars in the daytime.

In order to ſee the fixed ſtars in the day-time, it is neceſſary to exclude the extraneous light as much as poſſible. For this reaſon the greater the magnifying power of any teleſcope is, the more eaſily a fixed ſtar will be diſtinguiſhed in the day-time; the light of the ſtar remaining the ſame in all magnifying powers of the ſame teleſcope, but the ground upon which it is ſeen becoming darker by increaſing the magnifying power; and the viſibility of a ſtar depends very much upon the difference between its own light and that of the ground upon which it is obſerved. A fixed ſtar will be very nearly equally viſible with teleſcopes of very different apertures, provided the magnifying power remains the ſame.

91 Mr Epinus's propoſal for bending the tubes of teleſcopes.

M. Æpinus propoſes to bend the tubes of long teleſcopes at right angles, fixing a plane mirror in the angular point, in order to make them more commodious for viewing objects near the zenith; and he gives particular inſtructions how to make them in this form, eſpecially when they are furniſhed with micrometers. We are alſo informed that a little plane ſpeculum is ſometimes placed betwixt the laſt eye-glaſs and the eye in the reflecting teleſcopes, at an angle of 45°, for the ſame purpoſe.

92 Hiſtory of microſcopes.

The invention of MICROSCOPES was not much later than that of teleſcopes; and, according to Borellus, we are indebted for them to the ſame author, at leaſt to Zacharias Janſen, in conjunction with his ſon.

The Janſens, however, have not always enjoyed, undiſturbed, that ſhare of reputation to which they ſeem to be entitled, with reſpect either to the teleſcope or the microſcope. The diſcovery of the latter, in particular, has generally been conſidered as more uncertain than that of the former. All that many writers ſay we can depend upon is, that microſcopes were firſt uſed in Germany about the year 1621. Others ſay poſitively, that this inſtrument was the contrivance of Cornelius Drebell, a man of ingenuity, who alſo invented the thermometer.

According to Borellus, Zacharias Janſen and his ſon preſented the firſt microſcopes they had conſtructed to Prince Maurice, and Albert archduke of Auſtria. William Borell, who gives this account in a letter to his brother Peter, ſays, that when he was ambaſſador in England, in 1619, Cornelius Drebell, with whom he was intimately acquainted, ſhowed him a microſcope, which he ſaid was the ſame that the archduke had given him, and had been made by Janſen himſelf. This inſtrument was not ſo ſhort as they are generally made at preſent, but was ſix feet long, conſiſting of a tube of gilt copper, an inch in diameter, ſupported by three braſs pillars in the ſhape of dolphins, on a baſe of ebony, on which the ſmall objects were placed.

93 Microſcope made by Janſen.

This microſcope was evidently a compound one, or rather ſomething betwixt a teleſcope and a microſcope; ſo that it is poſſible that ſingle microſcopes might have been known, and in uſe, ſome time before: but perhaps nobody thought of giving that name to ſingle lenſes; though, from the firſt uſe of lenſes, they could not but have been uſed for the purpoſe of magnifying ſmall objects. In this ſenſe we have ſeen, that even the ancients were in poſſeſſion of microſcopes; and it appears from Jamblicus and Plutarch, quoted by Dr Rogers, that they gave ſuch inſtruments as they uſed for this purpoſe the name of *dioptra*. At what time lenſes were made ſo ſmall as we now generally uſe them for magnifying in ſingle microſcopes, we have not found. But as this muſt neceſſarily have been done gradually, the only proper object of inquiry is the invention of the double microſcope; and this is clearly given, by the evidence of Borellus above mentioned, to Z. Janſen, or his ſon.

The invention of compound microſcopes is claimed by the ſame Fontana who arrogated to himſelf the diſcovery of teleſcopes; and though he did not publiſh any account of this invention till the year 1646 (notwithſtanding he pretended to have made the diſcovery in 1618), Montucla, not from attending perhaps to the teſtimony of Borellus, is willing to allow his claim, as he thought there was no other perſon who ſeemed to have any better title to it.

Euſtachio Divini made microſcopes with two common object-glaſſes, and two plano-convex eye-glaſſes joined together on their convex ſides ſo as to meet in a point. The tube in which they were incloſed was very large, and the eye-glaſſes almoſt as broad as the palm of a man's hand. Mr Oldenburg, ſecretary to the royal ſociety, received an account of this inſtrument from Rome, and read it at one of their meetings, Auguſt 6. 1668. 94 By Divini.

It was about this time that Hartſocker improved ſingle microſcopes, by uſing ſmall globules of glaſs, made by melting them in the flame of a candle, inſtead of the lenſes which had before been made uſe of for that purpoſe. By this means he firſt diſcovered the *animalcula in ſemine maſculino*, which gave riſe to a new ſyſtem of generation. A microſcope of this kind, conſiſting of a globule of $\frac{1}{10}$ of an inch in diameter, M. Huygens demonſtrated to magnify 100 times; and ſince it is eaſy to make them of leſs than half a line in diameter, they may be made to magnify 300 times. 95 By Hartſocker.

But no man diſtinguiſhed himſelf ſo much by microſcopical diſcoveries as the famous M. Leeuwenhoek, though he uſed only ſingle lenſes with ſhort foci, preferring diſtinctneſs of viſion to a large magnifying power. 96 By Leeuwenhoek.

M. Leeuwenhoek's microſcopes were all ſingle ones, each of them conſiſting of a ſmall double convex glaſs, ſet in a ſocket between two ſilver plates rivetted together, and pierced with a ſmall hole; and the object was fixed on the point of a needle, which could be placed at any diſtance from the lens. If the objects were ſolid, he faſtened them with glue; and if they were fluid, or required to be ſpread upon glaſs, he placed them on a ſmall piece of Muſcovy talc, or thin glaſs; which he afterwards glued to his needle. He had, however, a different apparatus for viewing the circulation of the blood, which he could attach to the ſame microſcopes.

M. Leeuwenhoek bequeathed the greatest part of his microscopes to the Royal Society. They were placed in a small Indian cabinet, in the drawers of which were 13 little boxes, each of which contained two microscopes, neatly fitted up in silver.

The glass of all these lenses is exceedingly clear, but none of them magnifies so much as those globules which are frequently used in other microscopes. Mr Folkes, who examined them, thought that they showed objects with much greater distinctness, a circumstance which M. Leeuwenhoek principally valued. His discoveries, however, are to be ascribed not so much to the goodness of his glasses, as to his great experience in using them.

Mr Baker, who also examined these microscopes, and reported concerning them to the Royal Society, found that the greatest magnifier enlarged the diameter of an object about 160 times, but that all the rest fell much short of that power. He therefore concluded that M. Leeuwenhoek must have had other microscopes of a much greater magnifying power for many of his discoveries.

It appears from M. Leeuwenhoek's writings, that he was not unacquainted with the method of viewing opaque objects by means of a small concave reflecting mirror, which was afterwards improved by M. Lieberkhun. For, after describing his apparatus for viewing eels in glass tubes, he adds, that he had an instrument to which he screwed a microscope set in brass, upon which microscope he fastened a little dish of brass, probably that his eye might be thereby assisted to see objects better; for he says he had filed the brass which was round his microscope as bright as he could, that the light, while he was viewing objects, might be reflected from it as much as possible. This microscope, with its dish, is constructed upon principles so similar to those which are the foundation of our single microscope by reflection (see MICROSCOPE,) that it may well be supposed to have given the hint to the ingenious inventor of it.

97 Wilson's microscope.

In 1702, Mr Wilson made several ingenious improvements in the method of using single magnifiers, for the purpose of viewing transparent objects; and his microscope, which is also a necessary part of the solar microscope, is in very general use at this day, (See MICROSCOPE, sect. 1.)

98 Adams's method of making globules for large magnifiers.

In 1710, Mr Adams gave to the Royal Society the following account of his method of making small globules for large magnifiers. He took a piece of fine window-glass, and cut it with a diamond into several slips, not exceeding $\frac{1}{8}$ of an inch in breadth; then, holding one of them between the fore-finger and thumb of each hand over a very fine flame, till the glass began to soften, he drew it out till it was as fine as a hair, and broke; then putting each of the ends into the purest part of the flame, he had two globules, which he could increase or diminish at pleasure. If they were held a long time in the flame, they would have spots in them, so that he drew them out immediately after they became round. He broke off the stem as near to the globule as he could, and lodging the remainder between the plates, in which holes were drilled exactly round, the microscope, he says, performed to admiration. Through these magnifiers the same thread of very fine muslin appeared three or four times bigger than it did in the largest of Mr Wilson's magnifiers.

99 Temporary microscopes by Mr Grey.

The ingenious Mr Grey hit upon a very easy expedient to make very good temporary microscopes, at a very little expence. They consist of nothing but small drops of water, taken up with a point of a pin, and put into a small hole made in a piece of metal. These globules of water do not, indeed, magnify so much as those which are made of glass of the same size, because the refractive power of water is not so great; but the same purpose will be answered nearly as well by making them somewhat smaller.

The same ingenious person, observing that small heterogeneous particles inclosed in the glass of which microscopes are made, were much magnified when those glasses were looked through, thought of making his microscopes of water that contained living animalcula, to see how they would look in this new situation; and he found his scheme to answer beyond his expectation, so that he could not even account for their being magnified so much as they were: for it was much more than they would have been magnified if they had been placed beyond the globule, in the proper place for viewing objects. But Montucla observes, that, when any object is inclosed within this small transparent globule, the hinder-part of it acts like a concave mirror, provided they be situated between that surface and the focus; and that, by this means, they are magnified above $3\frac{1}{2}$ times more than they would have been in the usual way.

100 Microscopes of turpentine varnish by Dr Brewster.

Temporary microscopes of a different kind have been constructed by Dr Brewster. They were composed of turpentine varnish, which was formed into a plano-convex lens, by laying a drop of it upon a piece of plain glass: the under surface of the glass was then smoked, and the black pigment removed immediately below the fluid lens. These lenses lasted for a long time, and shewed objects distinctly, even when combined into a compound microscope. See *Appendix to Ferguson's Lectures*, vol. ii. and MICROSCOPE, p. 19.

101 Reflecting microscope, by Dr Barker.

After the successful construction of the reflecting telescope, it was natural to expect that attempts would also be made to render a similar service to microscopes. Accordingly we find two plans of this kind. The first was that of Dr Robert Barker. His instrument differs in nothing from the reflecting telescope, excepting the distance of the two speculums, in order to adapt it to those pencils of rays which enter the microscope diverging; whereas they come to the telescope from very distant objects nearly parallel to each other.

This microscope is not so easy to manage as those of the common kind. For vision by reflection, as it is much more perfect, so it is far more difficult than that by refraction. Nor is this microscope so useful for any but very small or transparent objects. For the object, being between the speculum and image, would, if it were large and opaque, prevent a due reflection.

102 Dr Smith's reflecting microscope superior to all others.

Dr Smith invented a double reflecting microscope, of which a theoretical and practical account is given in his remarks at the end of the second volume of his System of Optics. As it is constructed on principles different from all others, and, in the opinion of some, superior to them all, the reader will not be displeased with the following practical description.

Plate CCCLXXVII. fig. 2.

A section of this microscope is shewn in fig. 2. where ABC and *abc* are two specula, the former concave, and the latter convex, inclosed within the tube DEFG. The speculum ABC is perforated, and the object to be viewed

viewed is ſo placed between the centre and principal focus of that ſpeculum, that the rays flowing from it to ABC are reflected towards an image $p q$. But before that image is formed, they are intercepted by the convex ſpeculum $a b c$, and thence reflected through the hole BC in the vertex of the concave to a ſecond image $\pi\kappa$, to be viewed through an eye-glaſs l. The object may either be ſituated between the two ſpecula, or, which is perhaps better, between the principal focus and vertex c of the convex ſpeculum $a b c$, a ſmall hole being made in its vertex for the tranſmiſſion of the incident rays. When the microſcope is uſed, let the object be included between two little round plates of Muſcovy-glaſs, fixed in a hole of an oblong braſs plate $u m$, intended to ſlide cloſe to the back ſide of the convex ſpeculum: which muſt therefore be ground flat on that ſide, and ſo thin that the object may come preciſely to its computed diſtance from the vertex of the ſpeculum. The ſlider muſt be kept tight to the back of the metal by a gentle ſpring. The diſtance of the object being thus determined, diſtinct viſion to different eyes, and through different eye-glaſſes, muſt be procured by a gentle motion of the little tubes that contain theſe glaſſes. Theſe tubes muſt be made in the uſual form of thoſe that belong to Sir Iſaac Newton's reflecting teleſcope, having a ſmall hole in the middle of each plate, at the ends of the tube, ſituated exactly in each focus of the glaſs: The uſe of theſe holes and plates is to limit the viſible area, and prevent any ſtraggling rays from entering the eye. To the tube of the eye-glaſs is faſtened the arm g, on which the adjuſting ſcrew turns. A ſimilar arm u is attached to the fixed tube X, in which the neck of the ſcrew turns; and by turning the button y, the eye-tube is moved farther from or nearer to the object, by which means different ſorts of eyes obtain diſtinct viſion.

The rays which flow from the object directly through the hole in the concave ſpeculum and through the eye-glaſs, by mixing with the reflected rays, would dilute the image on the retina, and therefore muſt be intercepted. This is done by a very ſimple contrivance. The little hole in the convex ſpeculum is ground conical as in the figure; and a conical ſolid P, of which the baſe is larger than the orifice in the back of the convex ſpeculum, ſupported on the ſlender pillar PQ, is ſo placed as to intercept all the *direct* rays from the eye-glaſs. The tubes are ſtrongly blacked on their inſides, and likewiſe the conical ſolid, to hinder all reflection of rays upon the convex ſpeculum. The little baſe, too, of the ſolid ſhould be made concave, that whatever light it may ſtill reflect, may be thrown back upon the object; and its back-ſide being conical and blacked all over, will either abſorb or laterally diſperſe any ſtraggling rays which the concave ſpeculum may ſcatter upon it, and ſo prevent their coming to the eye-glaſs.

Notwithſtanding the interpoſition of this conical ſolid, yet when the eye-glaſs is taken out, diſtant objects may be diſtinctly ſeen through the microſcope, by rays reflected from the metals, and diverging upon the eye from an image behind the convex ſpeculum. But this mixture of foreign rays with thoſe of the object, which is common to all kinds of microſcopes in viewing tranſparent objects, is uſually prevented by placing before the object a thick double convex lens l, to collect the ſky-light exactly upon the object. This lens ſhould be juſt ſo broad as to ſubtend the oppoſite angle to that which the concave ſpeculum ſubtends at the object. The annular frame of the lens muſt be very narrow, and connected with the microſcope by two or three ſlender wires or blades, whoſe planes produced may paſs through the object, and intercept from it as little ſky-light as poſſible.

This is not the place for explaining the principles of this microſcope, or demonſtrating its ſuperiority over moſt others; nor are ſuch explanation and demonſtration neceſſary. Its excellence, as well as the principles upon which it is conſtructed, will be perceived by the reader, when he has made himſelf maſter of the laws of refraction and reflection as laid down in the ſequel of this article.

103 Solar microſcope, and that for opaque objects.

M. Lieberkuhn, in 1738 or 1739, made two capital improvements in microſcopes, by the invention of the *ſolar microſcope*, and the *microſcope for opaque objects*. When he was in England in the winter of 1739, he ſhowed an apparatus for each of theſe purpoſes, made by himſelf, to ſeveral gentlemen of the Royal Society, as well as to ſome opticians.

The microſcope for opaque objects remedies the inconvenience of having the dark ſide of an object next the eye. For by means of a concave ſpeculum of ſilver, highly poliſhed, in the centre of which a magnifying lens is placed, the object is ſo ſtrongly illuminated that it may be examined with all imaginable eaſe and pleaſure. A convenient apparatus of this kind, with four different ſpecula and magnifiers of different powers, was brought to perfection by Mr Cuff in Fleetſtreet. M. Lieberkuhn made conſiderable improvements in his ſolar microſcope, particularly in adapting it to the view of opaque objects; but in what manner this was effected, M. Æpinus, who was highly entertained with the performance, and who mentions the fact, was not able to recollect; and the death of the ingenious inventor prevented his publiſhing any account of it himſelf. M. Æpinus invites thoſe who came into the poſſeſſion of M. Lieberkuhn's apparatus to publiſh an account of this inſtrument; but it does not appear that his method was ever publiſhed.

This improvement of M. Lieberkuhn's induced M. Æpinus himſelf to attend to the ſubject; and he thus produced a very valuable improvement in this inſtrument. For by throwing the light upon the foreſide of any object by means of a mirror, before it is tranſmitted through the object-lens, all kinds of objects are equally well repreſented by it.

104 Reflected light introduced into the microſcope and magic lantern.

M. Euler propoſed to introduce viſion by reflected light into the magic lantern and ſolar microſcope, by which many inconveniences to which thoſe inſtruments are ſubject might be avoided. For this purpoſe, he ſays, that nothing is neceſſary but a large concave mirror, perforated as for a teleſcope; and the light ſhould be ſo ſituated, that none of it may paſs directly through the perforation, ſo as to fall on the images of the objects upon the ſcreen. He propoſes to have four different machines, for objects of different ſizes; the firſt for thoſe of ſix feet long, the ſecond for thoſe of one foot, the third for thoſe of two inches, and the fourth for thoſe of two lines; but it is needleſs to be particular in the deſcription of theſe, as more perfect inſtruments are deſcribed under the article MICROSCOPE.

Several improvements were made in the apparatus to the ſolar microſcope, as adapted to view opaque objects, by M. Zeiher, who made one conſtruction for the larger kind of objects, and another for the ſmall ones.

105 Mr Martin's improvement in the ſolar microſcope.

Mr Martin having conſtructed a ſolar microſcope of a larger ſize than common, for his own uſe, the illuminating lens being $4\frac{1}{2}$ inches in diameter, and all the other parts of the inſtrument in proportion, found, that by the help of an additional part, which he does not deſcribe, he could ſee even opaque objects very well. If he had made the lens any larger, he was aware that the heat produced at the focus would have been too great for moſt objects to bear. The expence of this inſtrument, he ſays, does not much exceed the price of the common ſolar microſcope.

106 Di Torre's extraordinary magnifying microſcope.

The ſmalleſt globules, and conſequently the greateſt magnifiers, for microſcopes, that have yet been executed, were made by T. Di Torre of Naples, who, in 1765, ſent four of them to the Royal Society. The largeſt of them was only two Paris points in diameter, and it was ſaid to magnify the diameter of an object 640 times. The ſecond was the ſize of one Paris point, and the third was no more than half of a Paris point, or the 144th part of an inch in diameter, and was ſaid to magnify the diameter of an object 2560 times. One

107 Could not be uſed by Mr Baker.

of theſe globules was wanting when they came into the hands of Mr Baker, to whoſe examination they were ſubmitted by the Royal Society. This gentleman, however, was not able to make any uſe of theſe. With that which magnifies the leaſt, he was not able to ſee any object with ſatisfaction; and he concludes his account with expreſſing his hopes only, that, as his eyes had been much uſed to microſcopes, they were not injured by the attention he had given to them, though he believed there were few perſons who would not have been blinded by it.

The conſtruction of a teleſcope with ſix eye-glaſſes led M. Euler to a ſimilar conſtruction of microſcopes, by introducing into them ſix lenſes, one of which admits of ſo ſmall an aperture, as to ſerve, inſtead of a diaphragm, to exclude all foreign light, though, as he ſays, it neither leſſens the field of view, nor the brightneſs of objects.

108 Difficulties attending the conſtruction of dioptric inſtruments.

The improvement of all dioptric inſtruments is greatly impeded by inequalities in the ſubſtance of the glaſs of which they are formed; but though many attempts have been made to make glaſs without that imperfection, none of them have been hitherto quite effectual. M. A. D. Merklein, having found ſome glaſs which had been melted when a building was on fire, and which proved to make excellent object-glaſſes for teleſcopes, concluded that its peculiar goodneſs aroſe from its not having been diſturbed when it was in a fluid ſtate; and therefore he propoſed to take the metal out of the furnace in iron veſſels, of the ſame form that was wanted for the glaſs; and after it had been perfectly fluid in thoſe veſſels, to let it ſtand to cool, without any diſturbance. This, however, is not always found to anſwer.

PART I. THEORY OF OPTICS.

THE ſcience of optics is commonly divided into three parts, *Dioptrics*, which treats of the laws of refraction, and the phenomena depending upon them; *Catoptrics*, which treats of the laws of reflection, and the phenomena connected with them; and, laſtly, *Chromatics*, which treats of the phenomena of colour. But this diviſion is of no uſe in a treatiſe of Optics, as moſt of the phenomena depend both on refraction and reflection, colour itſelf not excepted. For this reaſon, though we have given detached articles under the words DIOPTRICS, CATOPTRICS, and CHROMATICS; we have reſerved for this place the explanation of the laws of reflection and refraction, by which all optical phenomena may be explained.

CHAP. I. *On Light.*

109 Different opinions concerning the nature of light.

UNDER the article LIGHT we have given ſome account of the controverſies concerning its nature. The opinions of philoſophers may, in general, be arranged under theſe two: 1. That light is produced by the undulations of an elaſtic fluid, nearly in the ſame manner as ſound is produced by the undulations of the air. This opinion was firſt offered to the public by Des Cartes, and afterwards by Mr Huyghens. It was revived by Euler, and has lately found an able and ingenious defender in Dr Thomas Young.—2d, That the phenomena of viſion are produced by the motion and action of matter emitted from the ſhining body with immenſe velocity, moving uniformly in ſtraight lines, and acted on by other bodies; ſo as to be reflected, refracted, or inflected, in various ways, by means of forces which act on it in the ſame manner as on other inert matter. Sir Iſaac Newton has ably ſhown the diſſimilarity between the phenomena of viſion and the legitimate conſequences of the undulations of an elaſtic fluid. All M. Euler's ingenious and laborious diſcuſſions have not removed Newton's objections in the ſmalleſt degree. Sir Iſaac adopts the vulgar opinion, therefore, becauſe the difficulties attending this opinion are not inconſiſtent with the eſtabliſhed principles of mechanics, and are merely difficulties of conception to limited faculties like ours. We need not deſpair of being able to decide, by experiment, which of theſe opinions is neareſt to the truth; becauſe there are phenomena where the reſult ſhould be ſenſibly different in the two hypotheſes. At preſent, we ſhall content ourſelves with giving ſome account of the legitimate conſequences of the vulgar opinion, as modified by Sir Iſaac Newton, viz. that light conſiſts of ſmall particles emitted with very great velocity, and attracted or repelled by other bodies at very ſmall diſtances.

110 Light iſſues in ſtraight lines from each point in a luminous ſurface.

Every viſible body emits or reflects inconceivably ſmall particles of matter from each point of its ſurface, which iſſue from it continually, not unlike ſparks from a coal, in ſtraight lines and in all directions. Theſe

particles

Refraction. particles entering the eye, and ſtriking upon the retina (an expanſion of the optic nerve over the back part of the eye to receive their impulſes), excite in our minds the idea of light. And according as they differ in ſubſtance, denſity, velocity, or magnitude, they produce in us the ideas of different colours; as will be explained in its proper place.

That the particles which conſtitute light are exceedingly ſmall, appears from this, that if a hole be made through a piece of paper with a needle, rays of light from every object on the farther ſide of it are capable of being tranſmitted through it at once without the leaſt confuſion; for any one of thoſe objects may as clearly be ſeen through it, as if no rays paſſed through it from any of the reſt. Beſides, if a candle is lighted, and there be no obſtacle in the way to obſtruct the progreſs of its rays, it will fill all the ſpace within ſome miles of it every way with luminous particles, before it has loſt the leaſt ſenſible part of its ſubſtance in conſequence of this copious emiſſion.

It is evident that theſe particles proceed from every point of the ſurface of a viſible body, and in all directions, becauſe wherever a ſpectator is placed with regard to the body, every point of that part of the ſurface which is turned towards him is viſible. That they proceed from the body in right lines, we are aſſured, becauſe juſt ſo many and no more will be intercepted in their paſſage to any place by an interpoſed object, as that object ought to intercept, ſuppoſing them to come in ſuch lines.

The velocity with which they proceed from the ſurface of the viſible body is no leſs ſurpriſing than their minuteneſs: the method by which philoſophers eſtimate their velocity, is by obſervations made on the eclipſes of Jupiter's ſatellites; which eclipſes appear to us about ſeven minutes ſooner than they ought to do by calculation, when the earth is placed between the ſun and him, that is, when we are neareſt to him; and as much later, when the ſun is between him and us, at which time we are fartheſt from him. Hence it is concluded, that they require about ſeven minutes to paſs over a ſpace equal to the diſtance of the earth from the ſun.

A ſtream of theſe particles iſſuing from the ſurface of a viſible body in one and the ſame direction, is called a *ray of light*.

As rays proceed from a viſible body in all directions, they neceſſarily become thinner and thinner, continually ſpreading themſelves as they paſs along into a larger ſpace, and that in proportion to the ſquares of their diſtances from the body; that is, at the diſtance of two ſpaces, they are four times thinner than they are at one; at the diſtance of three ſpaces, nine times thinner, and ſo on.

CHAP. II. *On Refraction.*

111 Refraction defined.

LIGHT, when proceeding from a luminous body, is invariably found to proceed in ſtraight lines, without the leaſt deviation. But, if it happens to paſs obliquely from one medium to another, it always leaves the direction it had before, and aſſumes a new one; and this change of courſe is called its *refraction*. After having taken this new direction, it then proceeds invariably in a ſtraight line till it meets with a different medium, when it is again turned out of its courſe. It muſt be obſerved, however, that though by this means we may cauſe the rays of light to make any number of angles in their courſe, it is impoſſible to make them deſcribe a curve, except in one ſingle caſe, namely, where they paſs through a medium, the denſity of which uniformly either increaſes or decreaſes. This is the caſe with the light of the celeſtial bodies, which paſſes downwards through our atmoſphere, and likewiſe with that which is reflected upwards through it by terreſtrial objects. In both theſe caſes, it deſcribes a curve of the hyperbolic kind; but at all other times it proceeds in ſtraight lines, or in what may be taken for ſtraight lines without any ſenſible error.

Cauſe of Refraction.

SECT. I. *On the Cauſe of Refraction, and the Law by which it is performed.*

112 Phenomena of refraction ſolved by an attractive power in the medium.

THE phenomena of refraction are explained by an attractive power in the medium through which light paſſes, in the following manner. All bodies being endowed with an attractive force, which is extended to ſome diſtance beyond their ſurfaces; when a ray of light paſſes out of a rarer into a denſer medium (if this latter has a greater attractive force than the former, as is commonly the caſe), the ray, juſt before its entrance, will begin to be attracted towards the denſer medium; and this attraction will continue to act upon it, till ſome time after it has entered the medium; and therefore, if a ray approaches a denſer medium in a direction perpendicular to its ſurface, its velocity will be continually accelerated during its paſſage through the ſpace in which that attraction exerts itſelf; and therefore, after it has paſſed that ſpace, it will move on, till it arrive at the oppoſite ſide of the medium, with a greater degree of velocity than it had before it entered. So that in this caſe its velocity only will be altered. Whereas, if a ray enters a denſer medium obliquely, it will not only have its velocity augmented thereby, but its direction will become leſs oblique to the ſurface. Juſt as when a ſtone is thrown downwards obliquely from a precipice, it falls to the ſurface of the ground in a direction nearer to a perpendicular one, than that with which it was thrown from the hand. Hence we ſee a ray of light, in paſſing out of a rarer into a denſer medium, is refracted towards the perpendicular; that is, ſuppoſing a line drawn perpendicularly to the ſurface of the medium, through the point where the ray enters, and extended both ways, the ray in paſſing through the ſurface is refracted or bent towards the perpendicular line; or, which is the ſame thing, the line which it deſcribes by its motion after it has paſſed through the ſurface, makes a leſs angle with the perpendicular, than the line which it deſcribed before. Theſe poſitions may be illuſtrated in the following manner.

Plate CCCLXXVII. Fig. 3.

Let us ſuppoſe firſt, that the ray paſſes out of a vacuum into the denſer medium ABCD (fig. 3.), and that the attractive force of each particle in the medium is extended from its reſpective centre to a diſtance equal to that which is between the lines AB and EF, or AB and GH; and let KL be the path deſcribed by a ray of light in its progreſs towards the denſer medium. This ray, when it arrives at L, will enter the ſphere of attraction of thoſe particles which lie in AB the ſurface of the denſer medium, and will therefore ceaſe to proceed any longer in the right line KLM, but will be diverted from its courſe by being attracted towards

Cauſe of Refraction.

wards the line AB, and will begin to deſcribe the curve LN, paſſing through the ſurface AB in ſome new direction, as OQ; making a leſs angle with a line PR, drawn perpendicularly through the point N, than it would have done had it proceeded in its firſt direction KLM.

As we have ſuppoſed the attractive force of each particle to be extended through a ſpace equal to the diſtance between AB and EF, it is evident that the ray, after it has entered the ſurface, will ſtill be attracted downwards, till it has arrived at the line EF; for, till then, there will not be ſo many particles above it which will attract it upwards, as below, that will attract it downwards. So that after it has entered the ſurface at N, in the direction OQ, it will not proceed in that direction, but will continue to deſcribe a curve, as NS; after which it will proceed ſtraight on towards the oppoſite ſide of the medium, being attracted equally every way; and therefore will at laſt proceed in the direction XST, ſtill nearer the perpendicular PR than before.

If we ſuppoſe ABZY not to be a vacuum, but a rarer medium than the other, the caſe will ſtill be the ſame; but the ray will not be ſo much refracted from its rectilineal courſe, becauſe the attraction of the particles of the upper medium being in a contrary direction to that of the attraction of thoſe in the lower one, the attraction of the denſer medium will in ſome meaſure be deſtroyed by that of the rarer.

When a ray, on the contrary, paſſes out of a denſer into a rarer medium, if its direction be perpendicular to the ſurface of the medium, it will only loſe ſomewhat of its velocity, in paſſing through the ſpaces of attraction of that medium (that is, the ſpace wherein it is attracted more one way than it is another.) If its direction be oblique, it will continually recede from the perpendicular during its paſſage, and by that means have its obliquity increaſed, juſt as a ſtone thrown up obliquely from the ſurface of the earth increaſes its obliquity all the time it riſes. Thus, ſuppoſing the ray TS paſſing out of the denſer medium ABCD into the rarer ABZY, when it arrives at S it will begin to be attracted downwards, and ſo will deſcribe the curve SNL, and then proceed in the right line LK; making a larger angle with the perpendicular PR, than the line TSX in which it proceeded during its paſſage through the other medium.

We may here make a general obſervation on the forces which produce this deviation of the rays of light from their original path. They ariſe from the joint action of all the particles of the body which are ſufficiently near the particle of light; that is, whoſe diſtance from it is not greater than the line AE or GA; and therefore the whole force which acts on a particle in its different ſituations between the planes GH and EF, follows a very different law from the force exerted by one particle of the medium.

The ſpace through which the attraction of coheſion of the particles of matter is extended is ſo very ſmall, that in conſidering the progreſs of a ray of light out of one medium into another, the curvature it deſcribes in paſſing through the ſpace of attraction is generally neglected; and its path is ſuppoſed to be bent, or refracted, only in the point where it enters the denſer medium.

Law of Refraction.

Now the line which a ray deſcribes before it enters a denſer or a rarer medium, is called the *incident ray*; and that which it deſcribes after it has entered, is the *refracted ray*.

The angle comprehended between the incident ray and the perpendicular, is the *angle of incidence*; and that between the refracted ray and the perpendicular, is the *angle of refraction*.

There is a certain and immutable law, by which refraction is always performed; which is this: Whatever inclination a ray of light has to the ſurface of any medium before it enters it, the degree of refraction will always be ſuch, that the ſine of the angle of incidence and that of the angle of refraction, will always have a conſtant ratio to one another in that medium.

To illuſtrate this: Let us ſuppoſe ABCD (fig. 4.) to repreſent a rarer, and ABEF a denſer medium: let GH be a ray of light paſſing through the firſt and entering the ſecond at H, and let HI be the refracted ray: then ſuppoſing the perpendicular PR drawn through the point H, on the centre H, and with any radius, deſcribe the circle ABPR; and from G and I, where the incident and refracted rays cut the circle, let fall the lines GK and IL perpendicularly upon the line PR; the former of theſe will be the ſine of the angle of incidence, the latter of refraction. Now if in this caſe the ray GH is ſo refracted at H, that GK is double or triple, &c. of IL, then, whatever other inclination the ray GH might have had, the ſine of its angle of incidence would have been double or triple, &c. to that of its angle of refraction. For inſtance, had the ray paſſed in the line MH before refraction, it would have paſſed in ſome line as HN afterwards, ſo ſituated that MO ſhould have been double or triple, &c. of NQ. Plate CCCLXXVII. fig. 4.

The following table contains the refractive denſities of ſeveral bodies.

Diamond,	2.500
Flint-glaſs,	1.585
Plate glaſs,	1.502
Crown glaſs,	1.525
Sulphuric acid,	1.435
Solution of potaſh,	1.390
Olive oil,	1.469
Alcohol,	1.370
Atmoſpheric air,	1.000276
Ice,	1.31
Water,	1.336

This relation of the ſine of the angle of incidence to that of refraction, which is a propoſition of the moſt extenſive uſe in explaining the optical phenomena on phyſical or mechanical principles, may be demonſtrated in the following eaſy and familiar manner.

LEMMA I.

The augmentations or diminutions of the ſquares of the velocities produced by the uniform action of accelerating or retarding forces, are proportional to the forces, and to the ſpaces along which they act, jointly; or are proportional to the products of the forces multiplied by the ſpaces.

Let two bodies be uniformly accelerated from a ſtate of reſt in the points A a, along the ſpaces AB, $a\ b$, fig. 5. Fig. 5.

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5. by the accelerating forces F f, and let AC, ac, be ſpaces deſcribed in equal times; it is evident, from what has been ſaid under the articles GRAVITY and ACCELERATION, that becauſe theſe ſpaces are deſcribed with motions uniformly accelerated, AC and ac are reſpectively the halves of the ſpaces which would be uniformly deſcribed during the ſame time with the velocities acquired at C and c, and are therefore meaſures of theſe velocities. And as theſe velocities are uniformly acquired in equal times, they are meaſures of the accelerating forces. Therefore, $AC : ac = F : f$. Alſo, from the nature of uniformly accelerated motion, the ſpaces are proportional to the ſquares of the acquired velocities. Therefore, (uſing the ſymbols $\sqrt{}^2C$, $\sqrt{}^2c$, &c. to expreſs the ſquares of the velocities at C c, &c.) we have

Fig. 5.

$$\sqrt{}^2 B : \sqrt{}^2 C = AB : AC$$
$$\sqrt{}^2 C : \sqrt{}^2 c = AC^2 : ac^2$$
$$\sqrt{}^2 c : \sqrt{}^2 b = ac : ab$$

Therefore, by equality of compound ratios

$\sqrt{}^2 B : \sqrt{}^2 b = AB \times AC : ab \times ac, = AB \times F : ab \times f$.

And in like manner $\sqrt{}^2 D : \sqrt{}^2 d \sqrt{} AD \times F : ad \times f$;

and $\sqrt{}^2 B - \sqrt{}^2 D : \sqrt{}^2 b - \sqrt{}^2 d = BD \times F : bd \times f$. Q. E. D.

COROLLARY. If the forces are as the ſpaces inverſely, the augmentations or diminutions of the ſquares of the velocities are equal.

Remark. If DB, db, be taken extremely ſmall, the products $BD \times F$ and $bd \times f$ may be called the momentary actions of the forces, or the momentary increments of the ſquares of the velocities. It is uſually expreſſed, by the writers on the higher mechanics, by the ſymbol $f\dot{s}$, or fds, where f means the accelerating force, and $\dot{s}$ or ds means the indefinitely ſmall ſpace along which it is uniformly exerted. And the propoſition is expreſſed by the fluxionary equation $f\dot{s} = v\dot{v}$ becauſe $v\dot{v}$ is half the increment of v^2, as is well known.

LEMMA II.

Plate CCCLXXVII. fig. 6.

If a particle of matter, moving with any velocity along the line AC, be impelled by an accelerating or retarding force, acting in the ſame or in the oppoſite direction, and if the intenſity of the force in the different points B, F, H, C, &c. be as the ordinates BD, FG, &c. to the line DGE, the areas BFGD, BHKD, &c. will be as the changes made on the ſquare of the velocity at B, when the particle arrives at the points F, H, &c.

For let BC be divided into innumerable ſmall portions, of which let FH be one, and let the force be ſuppoſed to act uniformly, or to be of invariable intenſity during the motion along FH; draw GI perpendicular to HK: It is evident that the rectangle FHIG will be as the product of the accelerating force by the ſpace along which it acts, and will therefore expreſs the momentary increment of the ſquare of the velocity. (Lemma I.) The ſame may be ſaid of every ſuch rectangle. And if the number of the portions, ſuch as FH, be increaſed, and their magnitude diminiſhed without end, the rectangles will ultimately occupy the whole curvilineal area, and the force will therefore be as the finite changes made on the ſquare of the velocity, and the propoſition is demonſtrated.

COROLLARY. The whole change made on the ſquare of the velocity, is equal to the ſquare of that velocity which the accelerating force would communicate to the particle by impelling it along BC from a ſtate of reſt in B. For the area BCED will ſtill expreſs the ſquare of this velocity, and it equally expreſſes the change made on the ſquare of *any* velocity wherewith the particle may paſs through the point B, and is independent on the magnitude of that velocity.

Remark. The figure is adapted to the caſe where the forces all conſpire with the initial motion of the particle, or all oppoſe it, and the area expreſſes an augmentation or a diminution of the ſquare of the initial velocity. But the reaſoning would have been the ſame, although, in ſome parts of the line BC, the forces had conſpired with the initial motion, and in other parts had oppoſed it. In ſuch a caſe, the ordinates which expreſs the intenſity of the forces muſt lie on different ſides of the abſciſſa BC, and that part of the area which lies on one ſide muſt be conſidered as negative with reſpect to the other, and be ſubtracted from it. Thus, if the forces be repreſented by the ordinates of the dotted curve line DHe, which croſſes the abſciſſa in H, the figure will correſpond to the motion of a particle, which, after moving uniformly along AB, is ſubjected to the action of a variable accelerating force during its motion along BH, and the ſquare of its initial velocity is increaſed by the quantity BHD; after which it is retarded during its motion along HC, and the ſquare of its velocity in H is diminiſhed by a quantity HCe. Therefore the ſquare of the initial velocity is changed by a quantity BHD—HCe, or HCe—BHD.

This propoſition, which is the 39th of the 1ſt book of the Principia, is perhaps the moſt important in the whole ſcience of mechanics, being the foundation of every application of mechanical theory to the explanation of natural phenomena. No traces of it are to be found in the writings of philoſophers before the publication of Newton's Principia, though it is aſſumed by John Bernoulli and other foreign mathematicians, as an elementary truth, without any acknowledgment of their obligations to its author. It is uſually expreſſed by the equation $f\dot{s} = v\dot{v}$ and $\int f\dot{s} = v^2$, *i. e. the ſum of the momentary actions is equal to the whole or finite increment of the ſquare of the velocity.*

PROPOSITION.

113 The ratio of the ſine of incidence to the ſine of refraction. Plate CCCLXXVII. fig 7.

When light paſſes obliquely into or out of a tranſparent ſubſtance, it is refracted ſo that the ſine of the angle of incidence is to the ſine of the angle of refraction in the conſtant ratio of the velocity of the refracted light to that of the incident light.

LET ST, KR, repreſent two planes (parallel to, and equidiſtant from, the refracting ſurface XY) which bound the ſpace in which the light, during its paſſage, is acted on by the refracting forces.

The intenſity of the refracting forces being ſuppoſed equal at equal diſtances from the bounding planes, though anyhow different at different diſtances from them, may be repreſented by the ordinates T a, n q, p r, c R, &c. of the curve a b n p c, of which the form muſt be

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be determined from obſervation, and may remain for ever unknown. The phenomena of inflected light ſhow us that it is attracted by the refracting ſubſtance at ſome diſtances, and repelled at others.

Let the light, moving uniformly in the direction AB, enter the refracting ſtratum at B. It will not proceed in that direction, but its path will be incurvated upwards, while acted on by a repulſive force, and downwards, while impelled by an attractive force. It will deſcribe ſome curvilineal path B *d o* CDE, which AB touches in B, and will finally emerge from the refracting ſtratum at E, and move uniformly in a ſtraight line EF, which touches the curve in E. If, through *b*, the interſection of the curve of forces with its abſciſſa, we draw *b o*, cutting the path of the light in *o*, it is evident that this path will be concave upwards between B and *o*, and concave downwards between *o* and E. Alſo, if the initial velocity of the light has been ſufficiently ſmall, its path may be ſo much bent upwards, that in ſome point *d* its direction may be parallel to the bounding planes. In this caſe it is evident, that being under the influence of a repulſive force, it will be more bent upwards, and it will deſcribe *df*, equal and ſimilar to *d* B, and emerge in an angle *g f s*, equal to ABG. In this caſe it is reflected, making the angle of reflection equal to that of incidence. By which it appears how reflection, refraction, and inflection, are produced by the ſame forces and performed by the ſame laws.

But let the velocity be ſuppoſed ſufficiently great to enable the light to penetrate through the refracting ſtratum, and emerge from it in the direction EF; let AB and EF be ſuppoſed to be deſcribed in equal times: They will be proportional to the initial and final velocities of the light. Now, becauſe the refracting forces *muſt* act in a direction perpendicular to the refracting ſurface (ſince they ariſe from the joint action of all the particles of a homogeneous ſubſtance which are within the ſphere of mutual action), they cannot affect the motion of the light eſtimated in the direction of the refracting ſurface. If, therefore, AG be drawn perpendicular to ST, and FK to KR, the lines GB, EK, muſt be equal, becauſe they are the motions AB, EF, eſtimated in the direction of the planes. Draw now EL parallel to AB. It is alſo equal to it. Therefore, EL, EF, are as the initial and final velocities of the light. But EF is to EL as the ſine of the angle ELK to the ſine of the angle EFK; that is, as the ſine of the angle ABH to the ſine of the angle FEI; that is, as the ſine of the angle of incidence to the ſine of the angle of refraction.

By the ſame reaſoning it will appear that light, moving in the direction and with the velocity FE, will deſcribe the path EDB, and will emerge in the direction and with the velocity BA.

Let another ray enter the refracting ſtratum perpendicularly at B, and emerge at Q. Take two points N, P, in the line BQ, extremely near to each other, ſo that the refracting forces may be ſuppoſed to act uniformly along the ſpace NP: draw NC, PD, parallel to ST, CM perpendicular to DP, and MO perpendicular to CD, which may be taken for a ſtraight line. Then, becauſe the forces at C and N are equal, by ſuppoſition they may be repreſented by the equal lines CM and NP. The force NP is wholly employed in accelerating the light along NP; but the force CM being tranſverſe to the motion BD, is but partly ſo employed, and may be conceived as ariſing from the joint action of the forces CO, OM, of which CO only is employed in accelerating the motion of the light, while OM is employed in incurvating its path. Now it is evident, from the ſimilarity of the triangles DCM, MCO, that DC : CM = CM : CO, and that $DC \times CO = CM \times CM = NP \times NP$. But $DC \times CO$ and $NP \times NP$ are as the products of the ſpaces by the accelerating forces, and expreſs the momentary increments of the ſquares of the velocities at C and N. (Lemma 1.) Theſe increments, therefore, are equal. And as this muſt be ſaid of every portion of the paths BCE and BNQ, it follows that the whole increment of the ſquare of the initial velocity produced in the motion along BCE, is equal to the increment produced in the motion along BNQ. And, becauſe the initial velocities were equal in both paths, their ſquares were equal. Therefore the ſquares of the final velocities are alſo equal in both paths, and the final velocities themſelves are equal. The initial and final velocities are therefore in a conſtant ratio, whatever are the directions; and the ratio of the ſines of the angles of incidence and refraction being the ratio of the velocities of the refracted and incident light, by the former caſe of Prop. 1. is alſo conſtant.

Remark. The augmentation of the ſquare of the initial velocity is equal to the ſquare of the velocity which a particle of light would have acquired, if impelled from a ſtate of reſt at B along the line BQ. (Corol. of the Lemma 2.), and is therefore independent on the initial velocity. As this augmentation is expreſſed by the curvilineal area *a* T *b n p c* R, it depends both on the intenſity of the refracting forces, expreſſed by the ordinates, and on the ſpace through which they act, viz. TR. Theſe circumſtances ariſe from the nature of the tranſparent ſubſtance, and are characteriſtic of that ſubſtance. Therefore, to abbreviate language, we ſhall call this the *ſpecific velocity*.

This ſpecific velocity is eaſily determined for any ſubſtance in which the refraction is obſerved, by drawing L *i* perpendicular to EL, meeting in *i* the circle deſcribed with the radius EF. For E *i* being equal to EF, will repreſent the velocity of the refracted light, and EL repreſent the velocity of the incident light, and $E\,i = EL^2 + L\,i^2$, and therefore $L\,i^2$ is the augmentation of the ſquare of the initial velocity, and L *i* is the ſpecific velocity.

It will now be proper to deduce ſome corollaries from theſe propoſitions, tending to explain the chief phenomena of refraction. 114

The motion of light accelerated or retarded by refraction.

Cor. 1. When light is refracted towards the perpendicular to the refracting ſurface, it is accelerated; and it is retarded when it is refracted from the perpendicular. In the firſt caſe, therefore, it muſt be conſidered as having been acted on by forces conſpiring (in part at leaſt) with its motion, and *vice verſa*. Therefore, becauſe we ſee that it is always refracted towards the perpendicular, when paſſing from a void into any tranſparent ſubſtance, we muſt conclude that it is, on the whole, attracted by that ſubſtance. We muſt draw the ſame concluſion from obſerving, that it is refracted from the perpendicular in its paſſage out of any tranſparent ſubſtance whatever into a void. It has been attracted backwards by that ſubſtance.

This

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This acceleration of light in refraction is contrary to the opinibn of thoſe philoſophers who maintain, that illumination is produced by the undulation of an elaſtic medium. Euler attempts to prove, by mechanical laws, that the velocities of the incident and refracted light are proportional to the ſines of incidence and refraction, while our principles make them in this ratio inverſely. Boſcovich propoſed a fine experiment for deciding this queſtion. The aberration of the fixed ſtars ariſes from the combination of the motion of light with the motion of the teleſcope by which it is obſerved. Therefore this aberration ſhould be greater or leſs when obſerved by means of a teleſcope filled with water, according as light moves ſlower or ſwifter through water than through air. He was miſtaken in the manner in which the concluſion ſhould be drawn from the obſervation made in the form preſcribed by him: and the experiment has not yet been made in a convincing manner; becauſe no fluid has been found of ſufficient tranſparency to admit of the neceſſary magnifying power. It is an experiment of the greateſt importance to optical ſcience.

Cor. 2. If the light be moving within the tranſparent ſubſtance, and if its velocity (eſtimated in a direction perpendicular to the ſurface) do not exceed the ſpecific velocity of that ſubſtance, it will not emerge from it, but will be reflected backwards in an angle equal to that of its incidence. For it muſt be obſerved, that in the figure of laſt propoſition, the exceſs of the ſquare of EF above the ſquare of EL, is the ſame with the exceſs of the ſquare of KF above the ſquare of KL. (Plate CCCLXXVII. fig. 8.) Therefore the ſquare of the ſpecific velocity is equal to the augmentation or diminution of the ſquare of the perpendicular velocity. If therefore the initial perpendicular velocity FK be preciſely equal to the ſpecific velocity, the light will juſt reach the farther ſide of the attracting ſtratum, as at B, where its perpendicular velocity will be completely extinguiſhed, and its motion will be in the direction BT. But it is here under the influence of forces tending towards the plane KR, and its motion will therefore be ſtill incurvated towards it; and it will deſcribe a curve BD equal and ſimilar to EB, and finally emerge back from the refracting ſtratum into the tranſparent ſubſtance in an angle RDA equal to KEF.

If the direction of the light be ſtill more oblique, ſo that its perpendicular velocity is leſs than the ſpecific velocity, it will not reach the plane ST, but be reflected as ſoon as it has penetrated ſo far that the ſpecific velocity of the part penetrated (eſtimated by the compounding part of the area of forces) is equal to its perpendicular velocity. Thus the ray fE will deſcribe the path E d D a penetrating to $b\,d$, ſo that the correſponding area of forces $a\,b\,c\,e$ is equal to the ſquare of $f\,k$, its perpendicular velocity.

The extreme brilliancy of dew drops and of jewels had often excited the attention of philoſophers, and it always appeared a difficulty how light was reflected at all from the poſterior ſurface of tranſparent bodies. It afforded Sir Iſaac Newton his ſtrongeſt argument againſt the uſual theory of reflection, viz. that it was produced by impact on ſolid elaſtic matter. He was the firſt who took notice of the total reflection in great obliquities; and very properly aſked how it can be ſaid that there is any impact in this caſe, or that the reflecting impact ſhould ceaſe at a particular obliquity?

115 Rays at a certain obliquity are wholly reflected by tranſparent ſubſtances.

It muſt be acknowledged that it is a very curious circumſtance, that a body which is perfectly tranſparent ſhould ceaſe to be ſo at a certain obliquity; that a great obliquity ſhould not hinder light from paſſing from a void into a piece of glaſs; but that the ſame obliquity ſhould prevent it from paſſing from the glaſs into a void. The fineſt experiment for illuſtrating the fact is, to take two pieces of mirror-glaſs, not ſilvered, and put them together with a piece of paper between them, forming a narrow margin all round to keep them apart. Plunge this apparatus into water. When it is held nearly parallel to the ſurface of the water, every thing at the bottom of the veſſel will be ſeen clearly through the glaſſes; but when they are turned ſo as to be inclined about 50 degrees, they will intercept the light as much as if they were plates of iron. It will be proper to ſoak the paper in varniſh, to prevent water from getting between the glaſſes.

116 The brilliant cut in diamonds produces total reflection.

What is called the brilliant cut in diamonds, is ſuch a diſpoſition of the poſterior facets of the diamond, that the light is made to fall upon them ſo obliquely that none of it can go through, but all is reflected. To produce this effect in the greateſt poſſible degree is a matter of calculation, and merits the attention of the lapidary. When diamonds are too thin to admit of this form, they are cut in what is called the roſe faſhion. This has a plain back, and the facets are all on the front, and ſo diſpoſed as to refract the rays into ſufficient obliquities, to be ſtrongly reflected from the poſterior plane. Doublets are made by cutting one thin diamond roſe faſhion, and another ſimilar one is put behind it, with their plane ſurfaces joined. Or, more frequently, the outſide diamond has the anterior facets of the brilliant, and the inner has the form of the inner part of a brilliant. If they be joined with very pure and ſtrongly refracting varniſh, little light is reflected from the ſeparating plane, and their brilliancy is very conſiderable, though ſtill inferior to a true and deep brilliant. If no varniſh be uſed, much of the light is reflected from the flat ſide, and the effect of the poſterior facets is much diminiſhed. But doublets might be conſtructed, by making the touching ſurfaces of a ſpherical form (of which the curvature ſhould have a due proportion to the ſize of the ſtone), that would produce an effect nearly equal to that of the moſt perfect brilliant.

117 Refraction diminiſhes as the incident velocity increaſes.

Cor. 3. Since the change made on the ſquare of the velocity of the incident light is a conſtant quantity, it follows, that the refraction will diminiſh as the velocity of the incident light increaſes. For if L i in fig. 7. be a conſtant quantity, and EL be increaſed, it is evident that the ratio of E i, or its equal EF, to EL will be diminiſhed, and the angle LEF, which conſtitutes the refraction, will be diminiſhed. The phyſical cauſe of this is eaſily ſeen: When the velocity of the incident light is increaſed, it employs leſs time in paſſing through the refracting ſtratum or ſpace between the planes ST and KR, and is therefore leſs influenced by the refracting forces. A ſimilar effect would follow if the tranſparent body were moving with great velocity towards the luminous body.

Some naturaliſts have accounted for the different refrangibility

frangibility of the differently coloured rays, by ſuppoſing that the red rays move with the greateſt rapidity, and they have determined the difference of original velocity which would produce the obſerved difference of refraction. But this difference would be obſerved in the eclipſes of Jupiter's ſatellites. They ſhould be ruddy at their immerſions, and be ſome ſeconds before they attain their pure whiteneſs; and they ſhould become bluiſh immediately before they vaniſh in immerſions. This is not obſerved. Beſides, the difference in refrangibility is much greater in flint glaſs than in crown glaſs, and this would require a proportionally greater difference in the original velocities. The explanation therefore muſt be given up.

118 The refraction of a ſtar greater in the evening than in the morning.

It ſhould follow, that the refraction of a ſtar which is in our meridian at ſix o'clock in the evening ſhould be greater than that of a ſtar which comes on the meridian at ſix in the morning; becauſe we are moving away from the firſt, and approaching to the laſt. But the difference is but $\frac{1}{3000}$ of the whole, and cannot be obſerved with ſufficient accuracy in any way yet practiſed. A form of obſervation has been propoſed by Dr Blair, profeſſor of practical aſtronomy in the univerſity of Edinburgh, which promiſes a very ſenſible difference of refraction. It is alſo to be expected, that a difference will be obſerved in the refraction of the light from the eaſt and weſtern ends of Saturn's ring. Its diameter is about 26 times that of the earth, and it revolves in 10h. 32′; ſo that the velocity of its edge is about $\frac{1}{10000}$ of the velocity of the ſun's light. If therefore the light be reflected from it according to the laws of perfect elaſticity, or in the manner here explained, that which comes to us from the weſtern extremity will move more ſlowly than that which comes from the eaſtern extremity in the proportion of 2500 to 2501. And if Saturn can be ſeen diſtinctly after a refraction of 30° through a priſm, the diameter of the ring will be increaſed one half in one poſition of the teleſcope, and will be as much diminiſhed by turning the teleſcope half round its axis; and an intermediate poſition will exhibit the ring of a diſtorted ſhape. This experiment is one of the moſt intereſting to optical ſcience, as its reſult will be a ſevere touchſtone of the theories which have been attempted for explaining the phenomena on mechanical principles.

If the tail of a comet be impelled by the rays of the ſun, as is ſuppoſed by Euler and others, the light by which its extreme parts are ſeen by us muſt have its velocity greatly diminiſhed, being reflected by particles which are moving away from the ſun with immenſe rapidity. This may perhaps be diſcovered by its greater aberration and refrangibility.

119 All light ſubject to the ſame laws.

As common day light is nothing but the ſun's light reflected from terreſtrial bodies, it is reaſonable to expect that it will ſuffer the ſame refraction. But nothing but obſervation could aſſure us that this would be the caſe with the light of the ſtars; and it is rather ſurpriſing that the velocity of their light is the ſame with that of the ſun's light. It is a circumſtance of connexion between the ſolar ſyſtem and the reſt of the univerſe. It was as little to be looked for on the light of terreſtrial luminaries. If light be conceived as ſmall particles of matter emitted from bodies by the action of accelerating forces of any kind, the vaſt diverſity which we obſerve in the conſtitution of ſublunary bodies ſhould make us expect differences in this particular. Yet it is found, that the light of a candle, of a glow-worm, &c. ſuffers the ſame refraction, and conſiſts of the ſame colours. This circumſtance is adduced as an argument againſt the theory of emiſſion. It is thought more probable that this ſameneſs of velocity is owing to the nature of the medium, which determines the frequency of its undulations and the velocity of their propagation.

120 Law of refraction when light paſſes out of one tranſparent body into another contiguous to it.

Cor. 4. When two tranſparent bodies are contiguous, the light in its paſſage out of the one into the other will be refracted towards or from the perpendicular, according as the refracting forces of the ſecond are greater or leſs than thoſe of the firſt, or rather according as the area expreſſing the ſquare of the ſpecific velocity is greater or leſs. And as the difference of theſe areas is a determined quantity, the difference between the velocity in the medium of incidence and the velocity in the medium of refraction, will alſo be a determined quantity. Therefore the ſine of the angle of incidence will be in a conſtant ratio to the ſine of the angle of refraction; and this ratio will be compounded of the ratio of the ſine of incidence in the firſt medium to the ſine of refraction in a void; and the ratio of the ſine of incidence in a void to the ſine of refraction in the ſecond medium. If therefore a ray of light, moving through a void in any direction, ſhall paſs through any number of media bounded by parallel planes, its direction in the laſt medium will be the ſame as if it had come into it from a void.

Cor. 5. It alſo follows from theſe propoſitions, that if the obliquity of incidence on the poſterior ſurface of a tranſparent body be ſuch, that the light ſhould be reflected back again, the placing a maſs of the ſame or of another medium in contact with this ſurface, will cauſe it to be tranſmitted, and this the more completely, as the added medium is more denſe or more refractive; and the reflection from the ſeparating ſurface will be the more vivid in proportion as the poſterior ſubſtance is leſs denſe or of a ſmaller refractive power. It is not even neceſſary that the other body be in contact; it is enough if it be ſo near, that thoſe parts of the refracting ſtrata which are beyond the bodies interfere with or coincide with each other.

All theſe conſequences are agreeable to experience. The brilliant reflection from a dew-drop ceaſes when it touches the leaf on which it reſts: The brilliancy of a diamond is greatly damaged by moiſture getting behind it: The opacity of the combined mirror plates, mentioned in Cor. 2. is removed by letting water get between them: A piece of glaſs is diſtinctly or clearly ſeen in air, more faintly when immerſed in water, ſtill more faintly amidſt oil of olives, and it is hardly perceived in ſpirits of turpentine. Theſe phenomena are incompatible with the notion that reflection is occaſioned by impact on ſolid matter, whether of the tranſparent body, or of any ether or other fancied fluid behind it; and their perfect coincidence with the legitimate conſequences of the aſſumed principles, is a ſtrong argument in favour of the truth of thoſe principles.

121 An objection to the Newtonian theory of refraction.

It is worth while to mention here a fact taken notice of by Mr Beguelin, and propoſed as a great difficulty in the Newtonian theory of refraction. In order to get the greateſt poſſible refraction, and the ſimpleſt meaſure of the refracting power at the anterior ſurface of any

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tranſparent ſubſtance, Sir Iſaac Newton enjoins us to employ a ray of light falling on the ſurface *quam obliquiſſimè*. But Mr Beguelin found, that when the obliquity of incidence in glaſs was about 89° 50′, no light was refracted, but that it was wholly reflected. He alſo obſerved, that when he gradually increaſed the obliquity of incidence on the poſterior ſurface of the glaſs, the light which emerged laſt of all did not ſkim along the ſurface, making an angle of 90° with the perpendicular, as it ſhould do by the Newtonian theory, but made an angle of more than ten minutes with the poſterior ſurface. Alſo, when he began with very great obliquities, ſo that all the light was reflected back into the glaſs, and gradually diminiſhed the obliquity of incidence, the firſt ray of light which emerged did not ſkim along the ſurface, but was raiſed about 10 or 15 minutes.

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Shown to be the neceſſary conſequence of that theory, and of courſe a confirmation of it.

But all theſe phenomena are neceſſary conſequences of our principles, combined with what obſervation teaches us concerning the forces which bodies exert on the rays of light. It is evident, from the experiments of Grimaldi and Newton, that light is both attracted and repelled by ſolid bodies. Newton's ſagacious analyſis of theſe experiments diſcovered ſeveral alternations of actual inflection and deflection; and he gives us the preciſe diſtance from the body when ſome of theſe attractions end and repulſion commences; and the moſt remote action to be obſerved in his experiments is repulſion. Let us ſuppoſe this to be the caſe, although it be not abſolutely neceſſary. Let us ſuppoſe that the forces are repreſented by the ordinates of a curve *a b n p c* which croſſes the abſciſſa in *b*. Draw *b o* parallel to the refracting ſurface. When the obliquity of incidence of the ray AB has become ſo great, that its path in the glaſs, or in the refracting ſtratum, does not cut, but only touches the line *o b*, it can penetrate no further, but is totally reflected; and this muſt happen in all greater obliquities. On the other hand, when the ray LE, moving within the glaſs, has but a very ſmall perpendicular velocity, it will penetrate the refracting ſtratum no further than till this perpendicular velocity is extinguiſhed, and its path becomes parallel to the ſurface, and it will be reflected back. As the perpendicular velocity increaſes by diminiſhing the obliquity of incidence, it will penetrate farther; and the laſt reflection will happen when it penetrates ſo far that its path touches the line *ob*. Now diminiſh the obliquity by a ſingle ſecond; the light will get over the line *o b*, will deſcribe an arch *o d* B concave upwards, and will emerge in a direction BA, which does not ſkim the ſurface, but is ſenſibly raiſed above it. And thus the facts obſerved by M. Beguelin, inſtead of being an objection againſt this theory, afford an argument in its favour.

Plate CCCLXXVII. fig. 7.

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Euler's theory of undulation contrary to fact;

Cor. 6. Thoſe philoſophers who maintain the theory of undulation, are under the neceſſity of connecting the diſperſive powers of bodies with their mean refractive powers. M. Euler has attempted to deduce a neceſſary difference in the velocity of the rays of different colours from the different frequency of the undulations, which he aſſigns as the cauſe of their different colorific powers. His reaſoning on this ſubject is of the moſt delicate nature, and unintelligible to ſuch as are not completely maſter of the infiniteſimal calculus of partial differences, and is unſatisfactory to ſuch as are able to go through its intricacies. It is contradicted by fact. He ſays, that muſical ſounds which differ greatly in acuteneſs are propagated through the air with different velocities: but one of the ſmalleſt bells in the chimes of St Giles's church in Edinburgh was ſtruck againſt the rim of the very deep-toned bell on which the hours are ſtruck. When the ſound was liſtened to by a nice obſerver at the diſtance of more than two miles, no interval whatever could be obſerved. A ſimilar experiment was exhibited to M. Euler himſelf, by means of a curious inſtrument uſed at St Peterſburgh, and which may be heard at three or four miles diſtance. But the experiment with the bells is unexceptionable, as the two ſounds were produced in the very ſame inſtant. This connection between the refrangibility in general and the velocity muſt be admitted, in its full extent, in every attempt to explain refraction by undulation; and Euler was forced by it to adopt a certain conſequence which made a neceſſary connection between the mean refraction and the diſperſion of heterogeneous rays. Confident of his analyſis, he gave a deaf ear to all that was told him of Mr Dollond's improvements on teleſcopes, and aſſerted, that they could not be ſuch as were related; for an increaſe of mean refraction muſt always be accompanied with a *determined* increaſe of diſperſion. Newton had ſaid the ſame thing, being miſled by a limited view of his own principles; but the diſperſion aſſigned by him was different from that aſſigned by Euler. The diſpute between Euler and Dollond was confined to the deciſion of this queſtion only; and when ſome glaſſes made by a German chemiſt at Peterſburgh convinced Euler that his determination was erroneous, he did not give up the principle which had forced him to this determination of the diſperſion, but immediately introduced a new theory of the achromatic teleſcopes of Dollond; a theory which took the artiſts out of the track marked out by mathematicians, and in which they had made conſiderable advances, and led them into another path, propoſing *maxims* of construction hitherto untried, and inconſiſtent with real improvements which they had already made. The leading principle in this theory is to arrange the different ultimate images of a point which ariſe either from the errors of a ſpherical figure or different refrangibility, in a ſtraight line paſſing through the centre of the eye. The theory itſelf is ſpecious; and it requires great mathematical ſkill to accompliſh this point, and hardly leſs to decide on the propriety of the conſtruction which it recommends. It is therefore but little known. But that it is a falſe theory, is evident from one ſimple conſideration. In the moſt indiſtinct viſion ariſing from the worſt conſtruction, this rectilineal arrangement of the images obtains completely in that pencil which is ſituated in the axis, and yet the viſion is indiſtinct. But, what is to our preſent purpoſe, this new theory is purely mathematical, ſuiting any obſerved diſperſive power, and has no connection with the phyſical theory of undulations, or indeed with any mechanical principles whatever. But, by admitting any diſperſive power, whatever may be the mean refraction, all the phyſical doctrines in his *Nova Theoria Lucis et Colorum* are overlooked, and therefore never once mentioned, although the effects of M. Zeiher's glaſs are taken notice of as inconſiſtent with that mechanical propoſition of Newton's which occaſioned the whole diſpute between Euler and Dollond.

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and miſleads artiſts.

They are indeed inconſiſtent with the univerſality of that

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that proposition. Newton advances it in his Optics merely as a mathematical proposition highly probable, but says that it will be corrected if *he shall find it* false. The ground on which he *seems* (for he does not expressly say so) to rest its probability, is a limited view of his own principle, the action of bodies on light. He (not knowing any cause to the contrary) supposed that the action of all bodies was similar on the different kinds of light, that is, that the specific velocities of the differently coloured rays had a determined proportion to each other. This was gratuitous; and it might have been doubted by him who had observed the analogy between the chemical actions of bodies by elective attractions and repulsions, and the similar actions on light. Not only have different menstrua unequal actions on their solids, but the order of their affinities is also different. In like manner, we might expect not only that some bodies would attract light in general more than others, but also might differ in the proportion of their actions on the different kinds of light, and this so much, that some might even attract the red more than the violet. The late discoveries in chemistry show us some very distinct proofs, that light is not exempted from the laws of chemical action, and that it is susceptible of chemical combination. The changes produced by the sun's light on vegetable colours, show the necessity of illumination to produce the green fecula; and the aromatic oils of plants, the irritability of their leaves by the action of light, the curious effects of it on the mineral acids, on manganese, and the calces of bismuth and lead, and the imbibition and subsequent emission of it by phosphorescent bodies, are strong proofs of its chemical affinities, and are quite inexplicable on the theory of undulations.

All these considerations taken together, had they been known to Sir Isaac Newton, would have made him expect differences quite anomalous in the dispersive powers of different transparent bodies; at the same time that they would have afforded to his sagacious mind the strongest arguments for the actual emission of light from the luminous body.

Having in this manner established the observed law of refraction on mechanical principles, showing it to be a necessary consequence of the known action of bodies on light, we proceed to trace its mathematical consequences through the various cases in which it may be exhibited to our observation. These constitute that part of the mathematical branch of optical science which is called *dioptrics*.

125 The variation of the intensity of attractions and repulsions unknown.

We are quite unacquainted with the law of action of bodies on light, that is, with the variation of the intensity of the attractions and repulsions exerted at different distances. All that we can say is, that from the experiments and observations of Grimaldi, Newton, and others, light is deflected towards a body, or is attracted by it, at some distances, and repelled at others, and this with a variable intensity. The action may be extremely different, both in extent and force, in different bodies, and change by a very different law with the same change of distance. But, amidst all this variety, there is a certain similarity arising from the joint action of many particles, which should be noticed, because it tends both to explain the similarity observed in the refractions of light, and also its connexion with the phenomena of reflection.

126 The law of variation in the action of many particles different from that of one. Plate CCLXXVII. fig. 9.

The law of variation in the joint action of many particles adjoining to the surface of a refracting medium, is extremely different from that of a single particle; but when this last is known, the other may be found out. We shall illustrate this matter by a very simple case. Let DE be the surface of a medium, and let us suppose that the action of a particle of the medium on a particle of light extends to the distance EA, and that it is proportional to the ordinates ED, F*f*, G*g*, H*h*, &c. of the line A*h*C*gf*D; that is, that the action of the particle E of the medium on a particle of light in F, is to its action on a particle in H as F*f* to H*h*, and that it is attracted at F but repelled at H, as expressed by the situation of the ordinates with respect to the abscissa. In the line AE produced to B, make EB, Eχ, E$\varkappa$, Eγ, Eφ, &c. respectively equal to EA, EH, EC, EG, EF, &c.

It is evident that a particle of the medium at B will exert no action on the particle of light in E, and that the particles of the medium in $\varkappa\,\gamma\,\varphi$ E, will exert on it actions proportional to H*h*, G*g*, F*f*, ED. Therefore, supposing the matter of the medium continuous, the whole action exerted by the row of particles EB will be represented by the area A*h*CDE; and the action of the particles between B and φ will be represented by the area A*h*C*f*F, and that of the particles between E and φ by the area F*f*DE.

Now let the particle of light be in F, and take F*o* =AE. It is no less evident that the particle of light in F will be acted on by the particles in E*o* alone, and that it will be acted on in the same manner as a particle in E is acted on by the particles in φB. Therefore the action of the whole row of particles EB on a particle in F will be represented by the area A*h*C*f*F. And thus the action on a particle of light in any point of AE will be represented by the area which lies beyond it.

But let us suppose the particles of light to be within the medium, as at φ, and make $\varphi\,d$=AE. It is again evident that it is acted on by the particles of the medium between φ and *d* with a force represented by the area A*h*CDE, and in the opposite direction by the particles in Eφ with a force represented by the area F*f*DE. This balances an equal quantity of action, and there remains an action expressed by the area A*h*C*f*F. Therefore, if an equal and similar line to A*h*CDE be described on the abscissa EB, the action of the medium on a particle of light in φ will be represented by the area $\varphi f \varkappa\, h$ B, lying beyond it.

If we now draw a line AKLMRNPB, whose ordinates CK, FQ, φR, &c. are as the areas of the other curve, estimated from A and B; these ordinates will represent the whole forces which are exerted by the particles in EB, on a particle of light moving from A to B. This curve will cut the axis in points L, N such, that the ordinates drawn through them intercept areas of the first curve, which are equal on each side of the axis; and in these points the particle of light sustains no action from the medium. These points are very different from the similar points of the curve expressing the action of a single particle. These last are in the very places where the light sustains the greatest repulsive action

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tion of the whole row of particles. In the same manner may a curve be constructed, whose ordinates express the united action of the whole medium.

From these observations we learn in general, that a particle of light within the space of action is acted on with equal forces, and in the same direction, when at equal distances on each side of the surface of the medium.

Sect. II. *Of the focal distance of rays refracted by passing out of one medium into another of different density and through a plane surface.*

Lemma.

The indefinitely small variation of the angle of incidence is to the simultaneous variation of the angle of refraction as the tangent of incidence is to the tangent of refraction; or, the cotemporaneous variations of the angles of incidence and refraction are proportional to the tangents of these angles.

Plate cccLxxvii. fig. 10.

127 Laws of refraction in plane surfaces.

Let RVF, $r\,Vf$ (fig. 10.) be the progress of the rays refracted at V (the angle rVR being considered in its nascent or evanescent state), and VC perpendicular to the refracting surface VA. From C draw CD, CB perpendicular to the incident and refracted rays RV, VF, cutting r V, Vf in δ and β, and let Cd, Cb be perpendicular to r V, Vf.

Because the sines of incidence and refraction are in a constant ratio, their simultaneous variations are in the same constant ratio. Now the angle RVr is to the angle FVf in the ratio of $\frac{B\beta}{BV}$ to $\frac{D\delta}{DV}$; that is, of $\frac{BC}{BV}$ to $\frac{DC}{DV}$; that is, of $\frac{\text{sin. incid.}}{\text{cos. incid.}}$ to $\frac{\text{sin. refr.}}{\text{cos. refr.}}$; that is, of *tan. incid.* to *tan. refr.*

Corollary. The difference of these variations is to the greatest or least of them as the difference of the tangents to the greatest or least tangent.

Problem.

Plate cccLxxviii. figs. 1, 2, 3, 4.

Let two rays RV, RP diverge from, or converge to, a point R, and pass through the plane surface PV, separating two refracting mediums AB, of which let B be the most refracting, and let RV be perpendicular to the surface. It is required to determine the point of dispersion or convergence, F, of the refracted rays VD, PE.

Make VR to VG as the sine of refraction to the sine of incidence, and draw GIK parallel to the surface, cutting the incident ray in I. About the centre P, with the radius PI, describe an arch of a circle IF, cutting VR in F; draw PE tending from or towards F. We say PE is the refracted ray, and F the point of dispersion or convergence of the rays RV, RP, or the conjugate focus to R.

For since GI and PV are parallel, and PF equal to PI, we have PF : PR=PI : PR,=VG : VR,=sin. incid. : sin. refr. But PF : PR=sin. PRV : sin. PFV, and RRV is equal to the angle of incidence at P; therefore PFV is the corresponding angle of refraction, FPE is the refracted ray, and F the conjugate focus to R.

Cor. 1. If diverging or converging rays fall on the surface of a more refracting medium, they will diverge or converge less after refraction, F being farther from the surface than R. The contrary must happen when the diverging or converging rays fall on the surface of a less refracting medium, because, in this case, F is nearer to the surface than R.

Cor. 2. Let Rp be another ray, more oblique than RP, the refracting point p being farther from V, and let fpe be the refracted ray, determined by the same construction. Because the arches FI, fi, are perpendicular to their radii, it is evident that they will converge to some point within the angle RIK, and therefore will not cross each other between F and I; therefore Rf will be greater than RF, as RF is greater than RG, for similar reasons. Hence it follows, that all the rays which tended from or towards R, and were incident on the whole of VPp, will not diverge from or converge to F, but will be diffused over the line GFf. This diffusion is called aberration from the focus, and is so much greater as the rays are more oblique. No rays flowing from or towards R will have point of concourse with RV nearer to R than F is: But if the obliquity be inconsiderable, so that the ratio of RP to FP does not differ sensibly from that of RV to FV, the point of concourse will not be sensibly removed from G. G is therefore usually called the *conjugate focus* to R. It is the conjugate focus of an indefinitely slender pencil of rays falling perpendicularly on the surface. The conjugate focus of an oblique pencil, or even of two oblique rays, whose dispersion on the surface is considerable, is of more difficult investigation. See *Gravesande's Natural Philosophy* for a very neat and elementary determination (B).

In a work of this kind, it is enough to have pointed out, in an easy and familiar manner, the nature of optical aberration. But as this is the chief cause of the imperfection of optical instruments, and as the only method of removing this imperfection is to diminish this aberration, or correct it by a subsequent aberration in the opposite direction, we shall here give a fundamental and very simple proposition, which will (with obvious alterations) apply to all important cases. This is the determination of the focus of an infinitely slender pencil of oblique rays RP, Rp.

"Retaining the former construction for the ray PF, (fig. 1.)

(B) We refer to Gravesande, because we consider it of importance to make such a work as ours serve as a general index to science and literature. At the same time we take the liberty to observe, that the focus in question is virtually determined by the construction which we have given: for the points P, F of the line PF are determined, and therefore its position is also determined. The same is true of the position of pf, and therefore the intersection φ of the two lines is likewise determined.

Refraction by Spherical Surfaces.

(fig. 1.) suppose the other ray Rp infinitely near to RP. Draw PS perpendicular to PV, and Rr perpendicular to RP, and make Pr : PS=VR : VF. On Pr describe the semicircle rRP, and on PS the semicircle SφP, cutting the refracted ray PF in φ, draw pr, pS, $p\varphi$." It follows from the lemma, that if φ be the focus of refracted rays, the variation Pφp of the angle of refraction is to the corresponding variation PRp of the angle of incidence as the tangent of the angle of refraction VFP to the tangent of the angle of incidence VRP. Now Pp may be considered as coinciding with the arch of the semicircles. Therefore the angles PRp, Prp are equal, as also the angles Pφp, PSp. But PSp is to Prp as Pr to PS; that is, as VR to VF; that is, as the cotangent of the angle of incidence to the cotangent of the angle of refraction; that is, as the tangent of the angle of refraction to the tangent of the angle of incidence. Therefore the point φ is the focus.

Sect. III. *Of Refraction by Spherical Surfaces.*

Problem.

To find the focus of refracted rays, the focus of incident rays being given.

Plate cclxxviii. figs. 5, 6, &c.

Let PVπ (figs. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14,) be a spherical surface whose centre is C, and let the incident light diverge from or converge to R. Draw the ray RC through the centre, cutting the surface in the point V, which we shall denominate the *vertex*, while RC is called the *axis*. This ray passes on without refraction, because it coincides with the perpendicular to the surface.

128 The focus of rays refracted by spherical surfaces ascertained.

Let RP be another incident ray, which is refracted at P, draw the radius PC. In RP make RE to RP as the sine of incidence m to the sine of refraction n; and about the centre R, with the distance RE, describe the circle EK, cutting PC in K; draw RK and RF parallel to it, cutting the axis in F. PF is the refracted ray, and F is the focus.

For the triangles PCF, KCR are similar, and the angles at P and K are equal. Also RK is equal to RE, and RPD is the angle of incidence. Now $m : n$=RK : RP, =sin. DPR : sin. RKP, = sin. DPR : sin. CPF. Therefore CPF is the angle of refraction corresponding to the angle of incidence RPD, and PF is the refracted ray, and F the focus. Q. E. D.

Cor. 1. CK : CP=CR : CF, and $\text{CF}=\dfrac{\text{CP}\times\text{CR}}{\text{CK}}$.

Now CP$\times$CR is a constant quantity; and therefore CF is reciprocally as CK, which evidently varies with a variation of the arch VP. Hence it follows, that all the rays flowing from R are not collected at the conjugate focus F. The ultimate situation of the point F, as the point P gradually approaches to, and at last coincides with, V, is called *the conjugate focus of central rays*, and the distance between this focus and the focus of a lateral ray is called *the aberration* of that ray, arising from the spherical figure.

There are, however, two situations of the point R such, that all the rays which flow from it are made to diverge from one point. One of those is C (fig. 5.), because they all pass through without refraction, and therefore still diverge from C; the other is when rays in the rare medium with a convex surface flow from a point R, so situated beyond the centre that CV is to CR as the sine of incidence in the rare medium is to the sine of refraction in the denser, or when rays in the rare medium fall on the convex surface of the denser, converging to F, so situated that CF : CV= $m : n$. In this case they will all be dispersed from F, so situated that CV : CF=$n : m$, =CR : CV for sine RPC : sine PKC=$n : m$, =CR : CP, =sine RPC : sine PRC. Therefore the angle PRC is equal to PKC, or to FPC (by construction of the problem), and the angle C is common to the triangles PRC, FPC; they are therefore similar, and the angles PRC, FPC are equal, and $n : m$= CP : CF, =CK : CR, =CR : CP; therefore CP : CK= $\text{CP}^2 : \text{CR}^2$: but CP and CR are constant quantities, and therefore CK is a constant quantity, and (by the corollary) CF is a constant quantity, and all the rays flowing from R are dispersed from F by refraction. In like manner rays converging to F will by refraction converge to R. This was first observed by Huygens.

Cor. 2. If the incident ray R'P is parallel to the axis RC, we have PO to CO as the sine of incidence to the sine of refraction. For the triangles R'PK'PCO are similar, and PO : CO=R'K' : R'P, =$m : n$. Fig. 5.

Cor. 3. In this case, too, we have the focal distance of central parallel rays reckoned from the vertex = $\dfrac{n}{m-n}\times$VC. For since PO is ultimately VO, we have $m : n$=VO : CO, and $m-n : m$=VO—CO : VO, = VC : VO, and VO=$\dfrac{m}{m-n}\times$VC. This is called the principal focal distance, or focal distance of parallel rays. Also CO, the principal focal distance reckoned from the centre, =$\dfrac{n}{m-n}\times$VC.

N. B. When m is less than n, $m-n$ is a negative quantity.—Also observe, that in applying symbols to this computation of the focal distances, those lines are to be accounted positive which lie from their beginnings, that is, from the vertex, or the centre, or the radiant point, in the direction of the incident rays. Thus when rays diverge from R on the convex surface of a medium, VR is accounted negative and VC positive. If the light passes out of air into glass, m is greater than n; but if it passes out of glass into air, m is less than n. If, therefore, parallel rays fall on the convex surface of glass out of air, in which case $m : n$=3 : 2 very nearly, we have for the principal focal distance $\dfrac{3}{2-3}$VC, or +3VC. But if it pass out of glass into the convex surface of air, we have VO=$\dfrac{2}{2-3}$VC, or —2VC; that is, the focus O will be in the same side of the surface with the incident light. In like manner, we shall have for these two cases CO=+2VC and —3VC.

Cor. 4. By construction we have RK : RP=$m : n$

by similarity of triangles	PF : RK=CF : CR
therefore	PF : PR=mCF : nCR
and	m PR$\times$CF=n CR$\times$PF
therefore	m PR : n CR=PF : CF
and	m PR—n CR : m PR=PF—CF : PF
ultimately	m VR—n CR : m VR=VC : VF

This is a very general optical theorem, and affords an easy method for computing the focal distance of refracted rays.

For

Refraction by Spherical Surfaces.

For this purpose let VR, the distance of the radiant point, be expressed by the symbol r, the distance of the focus of refracted rays by the symbol f, and the radius of the spherical surface by a; we have

$$mr-n\overline{r-a} : mr=a : f, \text{ and}$$

$$f=\frac{mar}{mr-n\overline{r-a}}, =\frac{mar}{\overline{m-n}\,r+nd}.$$

In its application due attention must be paid to the qualities of r and a, whether they be positive or negative, according to the conditions of last corollary.

Plate cclxxviii. fig. 8.

Cor. 5. If Q be the focus of parallel rays coming from the opposite side, we shall have RQ : QC=RV : VF. For draw Cq parallel to PF, cutting RP in q; then Rq : qC=RP : PF. Now q is the focus of the parallel rays FP, Cq. And when the point P ultimately coincides with the point V, q must coincide with Q, and we have RQ : QC=RV : VF.

This is the most general optical theorem, and is equally applicable to lenses, or even to a combination of them, as to simple surfaces. It is also applicable to reflections, with this difference, that Q is to be assumed the focus of parallel rays coming the *same* way with the incident rays. It affords us the most compendious methods of computing symbolically and arithmetically the focal distances in all cases.

Cor. 6. We have also Rq : RP=RV : RF, and ultimately for central rays RQ : RV=RV : RF, and $RF=\frac{RV^2}{RQ}$. This proposition is true in lenses and mirrors, but not in single refracting surfaces.

Cor. 7. Also Rq : RC=RP : RF, and ultimately RQ : RV=RC : RF, and $RF=\frac{RV\times RC}{RQ}$. *N. B.* These four points Q, V, C, F, either lie all one way from P, or two of them forward and two backward.

Cor. 8. Also, making O the principal focus of rays coming the same way, we have Rq : q C=C o : o F, and ultimately RQ : Q c=c O : OF, and $OF=\frac{QC\times CO}{RQ}$, and therefore reciprocally proportional to RQ, because QC$\times co$ is a constant quantity.

These corollaries or theorems give us a variety of methods for finding the focus of refracted rays, or the other points related to them; and each formula contains four points, of which any three being given, the fourth may be found. Perhaps the last is the most simple, as the quantity $oc+c$Q is always negative, because o and Q are on different sides.

Cor. 9. From this construction we may also derive a very easy and expeditious method of drawing many refracted rays. Draw through the centre C (fig. 15. 16.) a line to the point of incidence P, and a line CA parallel to the incident ray RP. Take VO to VC as the sine of incidence to the sine of refraction, and about A, with the radius VO, describe an arch of a circle cutting PC produced in B. Join AB: and PF parallel to AB is the refracted ray. When the incident light is parallel to RC, the point A coincides with V, and a circle described round V with the distance VO will cut the lines PC, pC, &c. in the points Bb. The demonstration is evident.

Having thus determined the focal distance of refracted rays, it will be proper to point out a little more particularly its relation to its conjugate focus of incident rays. We shall consider the four cases of light incident on the convex or concave surface of a denser or a rarer medium.

Refraction by Spherical Surfaces.

Fig. 5. to fig. 14.

1. Let light moving in air fall on the convex surface of glass. Let us suppose it tending to a point beyond the glass infinitely distant. It will be collected to its principal focus o beyond the vertex V. Now let the incident light converge a little, so that R is at a great distance beyond the surface. The focus of refracted rays F will be a little within O or nearer to V. As the incident rays are made to converge more and more, the point R comes nearer to V, and the point F also approaches it, but with a much slower motion, being always situated between O and C till it is overtaken by R at the centre C, when the incident light is perpendicular to the surface in every point, and therefore suffers no refraction. As R has overtaken F at C, it now passes it, and is again overtaken by it at V. Now the point R is on the side from which the light comes, that is, the rays diverge from R. After refraction they will diverge from F a little without R; and as R recedes farther from V, F recedes still farther, and with an accelerated motion, till, when R comes to Q, F has gone to an infinite distance, or the refracted rays are parallel. When R still recedes, F now appears on the other side, or beyond V; and as R recedes back to an infinite distance, F has come to O: and this completes the series of variations, the motion of F during the whole changes of situation being in the same direction with the motion of R.

2. Let the light moving in air fall on the concave surface of glass; and let us begin with parallel incident rays, conceiving, as before, R to lie beyond the glass at an infinite distance. The refracted rays will move as if they came from the principal focus O, lying on that side of the glass from which the light comes. As the incident rays are made gradually more converging, and the point of convergence R comes toward the glass, the conjugate focus F moves backward from O; the refracted rays growing less and less diverging, till the point R comes to Q, the principal focus on the other side. The refracted rays growing parallel, or F has retreated to an infinite distance. The incident light converging still more, or R coming between Q and V, F will appear on the other side, or beyond the surface, or within the glass, and will approach it with a retarded motion, and finally overtake R at the surface of the glass. Let R continue its motion backwards (for it has all the while been moving backwards, or in a direction contrary to that of the light); that is, let R now be a radiant point, moving backwards from the surface of the glass. F will at first be without it, but will be overtaken by it at the centre C, when the rays will suffer no refraction. R still receding will get without F; and while R recedes to an infinite distance, F will recede to O, and the series will be completed.

3. Let the light moving in glass fall on the convex surface of air; that is, let it come out of the concave surface of glass, and let the incident rays be parallel, or tending to R, infinitely distant: they will be dispersed by refraction from the principal focus O within the glass. As they are made more converging, R comes

On Lenses. comes nearer, and F retreats backward, till R comes to Q, the principal focus without the glass; when F is now at an infinite distance within the glass, and the refracted rays are parallel. R still coming nearer, F now appears before the glass, overtakes R at the centre C, and is again overtaken by it at N. R now becoming a radiant point within the glass, F follows it backwards, and arrives at O, when R has receded to an infinite distance, and the series is completed.

4. Let the incident light, moving in glass, fall on the concave surface of air, or come out of the convex surface of glass. Let it tend to a point R at an infinite distance without the glass. The refracted rays will converge to O, the principal focus without the glass. As the incident light is made more converging, R comes towards the glass, while F, setting out from v, also approaches the glass, and R overtakes it at the surface V. R now becomes a radiant point within the glass, receding backwards from the surface. F recedes slower at first, but overtakes R at the centre C, and passes it with an accelerated motion to an infinite distance; while R retreats to Q, the principal focus within the glass. R still retreating, F appears before the glass; and while R retreats to an infinite distance, F comes to V, and the series is completed.

Sect. IV. *On Lenses.*

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Lenses, how many.

Lenses for optical purposes may be ground into nine different shapes. Lenses cut into five of those shapes, together with their axes, are described in vol. vi. page 33. (See Dioptrics). The other four are,

Plate CCCLXXIX. figs. 1, 2.

1. A *plane glass*, which is flat on both sides, and of equal thickness in all its parts, as EF, fig. 1.

2. A *flat plano-convex*, whose convex side is ground into several little flat surfaces, as A, fig. 2.

3. A *prism*, which has three flat sides, and when viewed endwise appears like an equilateral triangle, as B.

4. A *concavo-convex* glass, or *meniscus*, as C, which is seldom made use of in optical instruments.

Fig. 1. A ray of light G*h* falling perpendicularly on a plane glass EF, will pass through the glass in the same direction *hi*, and go out of it into the air in the same straight line *i*H.

A ray of light AB falling obliquely on a plane glass, will go out of the glass in the same direction, but not in the same straight line: for in touching the glass, it will be refracted in the line BC; and in leaving the glass, it will be refracted in the line CD.

Lemma.

Fig. 3. to 6. There is a certain point E within every double convex or double concave lens, through which every ray that passes will have its incident and emergent parts QA, *aq* parallel to each other: but in a plano-convex or plano-concave lens, that point E is removed to the vertex of the concave or convex surface; and in a meniscus, and in that other concavo-convex lens, it is removed a little way out of them, and lies next to the surface which has the greatest curvature.

For let RE*r* be the axis of the lens joining the centres R, *r* of its surfaces A, *a*. Draw any two of their semidiameters RA, *ra* parallel to each other, and join the point, A, *a*, and the line A*a* will cut the axis in the point E above described. For the triangles REA, *r*E*r* being equiangular, RE will be to E*r* in the given ratio of the semidiameters RA, *ra*; and consequently the point E is invariable in the same lens. Now supposing a ray to pass both ways along the line A*a*, it being equally inclined to the perpendiculars to the surfaces, will be equally bent, and contrariwise in going out of the lens; so that its emergent parts AQ *aq* will be parallel. Now any of these lenses will become plano-convex or plano-concave, by conceiving one of the semidiameters RA, *ra* to become infinite, and consequently to become parallel to the axis of the lens, and then the other semidiameter will coincide with the axis; and so the points A, E or *a*, E will coincide. Q. E. D.

Corol. Hence when a pencil of rays falls almost perpendicularly upon any lens, whose thickness is inconsiderable, the course of the ray which passes through E, above described, may be taken for a straight line passing through the centre of the lens without sensible error in sensible things. For it is manifest from the length of A*a*, and from the quantity of the refractions at its extremities, that the perpendicular distance of AQ, *aq*, when produced, will be diminished both as the thickness of the lens and the obliquity of the ray is diminished.

Prop. I.

To find the focus of parallel rays falling almost perpendicularly upon any given lens.

Let E be the centre of the lens, and *r* the centres of its surfaces, R*r* its axis, *g*EG a line parallel to the incident rays upon the surface B, whose centre is R. Parallel to *g*E draw a semidiameter BR, in which produced let V be the focus of the rays after their first refraction at the surface B, and joining V*r* let it cut *g*E produced in G, and G will be the focus of the rays that emerge from the lens. Fig. 7. to 12.

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The focus of parallel rays falling perpendicularly upon any lens.

For since V is also the focus of the rays incident upon the second surface A, the emergent rays must have their focus in some point of that ray which passes straight through this surface; that is, in the line V*r*, drawn through its centre *r*: and since the whole course of another ray is reckoned a straight line *g*EG ‡, its intersection G with V*r* determines the focus of them all. Q. E. D.

‡ Corol. from Lemma.

Corol. 1. When the incident rays are parallel to the axis *r*R, the focal distance EF is equal to EG. For let the incident rays that were parallel to *g*E be gradually more inclined to the axis till they become parallel to it; and their first and second foci V and G will describe circular arches NT and GF whose centres are R and E. For the line RV is invariable; being in proportion to RB in a given ratio of the lesser of the sines of incidence and refraction to their difference (by a former proposition); consequently the line EG is also invariable, being in proportion to the given line RV in the given ratio of *r*E to *r*R, because the triangles EG*r*, RV*r* are equiangular.

Corol. 2. The last proportion gives the following rule for finding the focal distance of any thin lens. As R*r*, the interval between the centres of the surfaces, is is to rE, the semidiameter of the second surface, so is RV or RT, the continuation of the first semidiameter to the first focus, to EG or EF the focal distance of the lens; which, according as the lens is thicker or thinner in the middle than at its edges, must lie on the same side as the emergent rays, or on the opposite side.

Corol. 3. Hence when rays fall parallel on both sides of any lens, the focal distances EF, Ef are equal. For let rt be the continuation of the semidiameter Er to the first focus t of rays falling parallel upon the surface A; and the same rule that gave $rR : rE = RT : EF$, gives also $rR : RE = rt : Ef$. Whence $Ef = EF$, because the rectangles $rE \times BT = RE \times rt$. For rE is to rt and also RE to RT in the same given ratio.

Corol. 4. Hence in particular in a double convex or double concave lens made of glass, it is as the sum of their semidiameters (or in a meniscus as their difference) to either of them, so is double the other, to the focal distance of the glass. For the continuations RT, rt are severally double their semidiameters: because in *glass $ET : TR$ and also $Et : tr = 3 : 2$.

Corol. 5. Hence if the semidiameters of the surfaces of the glass be equal, its focal distance is equal to one of them; and is equal to the focal distance of a plano-convex or plano-concave glass whose semidiameter is as short again. For considering the plane surface as having an infinite semidiameter, the first ratio of the last mentioned proportion may be reckoned a ratio of equality.

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The focus of emergent rays found. Plate CCCLXXX. fig. 1. to 6.

Prop. II.

The focus of incident rays upon a single surface, sphere, or lens, being given, it is required to find the focus of the emergent rays.

Let any point Q be the focus of incident rays upon a spherical surface, lens, or sphere, whose centre is E; and let other rays come parallel to the line QEq the contrary way to the given rays, and after refraction let them belong to a focus F; then taking Ef equal to EF the lens or sphere, but equal to FC in the single surface, say as QF to FE so Ef to fq; and placing fq the contrary way from f to that of FQ from F, the point q will be the focus of the refracted rays, without sensible error; provided the point Q be not so remote from the axis, nor the surfaces so broad, as to cause any of the rays to fall too obliquely upon them.

For with the centre E and semidiameters EF and Ef describe two arches FG, fg cutting any ray $QAaq$ in G and g, and draw EG and Eg. Then supposing G to be a focus of incident rays (as GA), the emergent rays (as agq) will be parallel to GE *; and on the other hand supposing g another focus of incident rays (as ga), the emergent rays (as AGQ) will be parallel to gE. Therefore the triangles QGE, Egq are equiangular, and consequently $QG : GE = Eg : gq$; that is, when the ray $QAaq$ is the nearest to QEq, $QF : FE = Ef : fg$. Now when Q accedes to F and coincides with it, the emergent rays become parallel, that is, q recedes to an infinite distance; and consequently when Q passes to the other side of F, the focus q will also pass through an infinite space from one side of f to the other side of it. Q. E. D.

* By Corol. from former Prop.

Corol. 1. In a sphere or lens the focus q may be found by this rule: $QF : QE = QE : Qq$, to be placed the same way from Q as QF lies from Q.—For let the incident and emergent rays QA, qa be produced till they meet in e; and the triangles QGE, Qeq being equiangular, we have $QG : QE = Qe : Qq$; and when the angles of these triangles are vanishing, the point e will coincide with E; because in the sphere the triangle Aea is equiangular at the base Aa, and consequently Ae and ae will at last become semidiameters of the sphere. In a lens the thickness Aa is inconsiderable.

The focus may also be found by this rule;—$QF : FE = QE : Eq$, for $QG : GE = QA : Aq$.—And then the rule formerly demonstrated for single surfaces holds good for the lenses.

Corol. 2. In all cases the distance fq varies reciprocally as FQ does; and they lie contrariwise from f and F; because the rectangle or the square under EF and Ef, the middle terms in the foregoing proportions, is invariable.

The principal focal distance of a lens may not only be found by collecting the rays coming from the sun, considered as parallel, but also (by means of this proposition) it may be found by the light of a candle or window. For, because $Qq : qA = QE : EG$, we have (when A coincides with E) $Qq : qE = QE : EF$; that is, the distance observed between the radiant object and its picture in the focus is to the distance of the lens from the focus as the distance of the lens from the radiant is to its principal focal distance. Multiply therefore the distances of the lens from the radiant and focus, and divide the product by their sum.

Corol. 3. Convex lenses of different shapes that have equal focal distance when put into each others places, have equal powers upon any pencil of rays to refract them to the same focus. Because the rules above-mentioned depend only upon the focal distance of the lens, and not upon the proportion of the semidiameters of its surfaces.

Corol. 4. The rule that was given for a sphere of an uniform density, will serve also for finding the focus of a pencil of rays refracted through any number of concentric surfaces, which separate uniform mediums of any different densities. For when rays come parallel to any line drawn through the common centre of these mediums, and are refracted through them all, the distance of their focus from that centre is invariable, as in an uniform sphere.

Corol. 5. When the focuses Q, q lie on the same side of the refracting surfaces, if the incident rays flow from Q, the refracted rays will also flow from q; and if the incident rays flow towards Q, the refracted will also flow towards q: and the contrary will happen when Q and q are on contrary sides of the refracting surfaces. Because the rays are continually going forwards.

From this proposition we also derive an easy method of drawing the progress of rays through any number of lenses ranged on a common axis.

Let A, B, C, be the lenses, and RA a ray incident on the first of them. Let α, β, κ, be their foci for parallel rays coming in the opposite direction; draw the perpendicular ad, cutting the incident ray in d, and draw da through the centre of the lens: AB parallel to Fig. 7.

to $d\,a$ will be the ray refracted by the firſt lens. Through the focus of the ſecond lens draw the perpendicular $\beta\,e$, cutting AB in e; and draw $e\,b$ through the centre of the ſecond lens. BD parallel to $b\,e$ will be the next refracted ray. Through the focus $\varkappa$ of the third lens draw the perpendicular $\varkappa f$, cutting BD in f, and draw $f\,c$ through the centre of the third lens. CE parallel to $f\,c$, will be the refracted ray; and ſo on.

Sect. V. *On Viſion.*

Having deſcribed how the rays of light, flowing from objects, and paſſing through convex glaſſes, are collected into points, and form the images of external objects; it will be eaſy to underſtand how the rays are refracted by the humours of the eye, and are thereby collected into innumerable points on the retina, on which they form the images of the objects from which they flow. For the different humours of the eye, and particularly the cryſtalline, are to be conſidered as a convex glaſs; and the rays in paſſing through them as affected in the ſame manner in the one as in the other. A deſcription of the coats and humours, &c. has been given in Anatomy; but it will be proper to repeat as much of the deſcription as will be ſufficient for our preſent purpoſe.

Plate CCCLXXX fig. 8.

132 Deſcription of the eye.

The eye is nearly globular, and conſiſts of three coats and three humours. The part DHHG of the outer coat, is called the *ſclerotica;* the reſt, DEFG, the *cornea.* Next within this coat is that called the *choroides,* which ſerves as it were for a lining to the other, and joins with the iris, $m\,n$, $m\,n$. The iris is compoſed of two ſets of muſcular fibres; the one of a circular form, which contracts the hole in the middle called the *pupil,* when the light would otherwiſe be too ſtrong for the eye; and the other of radical fibres, tending everywhere from the circumference of the iris towards the middle of the pupil; which fibres, by their contraction, dilate and enlarge the pupil when the light is weak, in order to let in a greater quantity of it. The third coat is only a fine expanſion of the optic nerve L, which ſpreads like net work all over the inſide of the choroides, and is therefore called the *retina;* upon which are thrown the images of all viſible objects.

Under the cornea is a fine tranſparent fluid like water, thence called the *aqueous humour.* It gives a protuberant figure to the cornea, fills the two cavities $m\,m$ and $n\,n$, which communicate by the pupil P; and has the ſame limpidity, ſpecific gravity, and refracting power, as water. At the back of this lies the cryſtalline humour II, which is ſhaped like a double convex glaſs; and is a little more convex on the back than the fore part. It converges the rays, which paſs through it from every viſible object to its focus at the bottom of the eye. This humour is tranſparent like cryſtal, is of the conſiſtence of hard jelly, and is to the ſpecific gravity of water as 11 to 10. It is encloſed in a fine tranſparent membrane, called the capſule of the cryſtalline lens, from which proceed radial fibres $o\,o$, called the *ciliary ligaments,* all around its edge, and join to the circumference of the iris.

At the back of the cryſtalline, lies the *vitreous* humour KK, which is tranſparent like glaſs, and is largeſt of all in quantity, filling the whole orb of the eye, and giving it a globular ſhape. It is much of a conſiſtence with the white of an egg, and very little exceeds the ſpecific gravity and refractive power of water.

133 The objects on the retina of the eye are inverted.

As every point of an object ABC, ſends out rays in all directions, ſome rays, from every point on the ſide next the eye, will fall upon the cornea between E and F; and by paſſing on through the pupil and humours of the eye, they will be converged to as many points on the retina or bottom of the eye, and will form upon it a diſtinct inverted picture $c\,b\,a$, of the object. Thus, the pencil of rays $q\,r\,s$ that flows from the point A of the object, will be converged to the point a on the retina; thoſe from the point B will be converged to the point b; thoſe from the point C will be converged to the point c; and ſo of all the intermediate points: by which means the whole image $a\,b\,c$ is formed, and the object made viſible; though it muſt be owned, that the method by which this ſenſation is conveyed by the optic nerve from the eye to the brain, and there diſcerned, is above the reach of our comprehenſion. Fig. 8.

That viſion is effected in this manner, may be demonſtrated experimentally. Take a bullock's eye whilſt it is freſh; and having cut off the three coats from the back part, quite to the vitreous humour, put a piece of white paper over that part, and hold the eye towards any bright object, and you will ſee an inverted picture of the object upon the paper, or the ſame thing may be better accompliſhed by paring the ſclerotic coat ſo thin that it becomes a little tranſparent, and retains the vitreous humour.

134 Why they are ſeen upright.

Since the image is inverted, many have wondered why the object appears upright. But we are to conſider, 1. That *inverted* is only a relative term: and, 2. That there is a very great difference between the real object and the image by which we perceive it. When all the parts of a diſtant proſpect are painted upon the retina, they are all right with reſpect to one another, as well as the parts of the proſpect itſelf; and we can only judge of an object's being inverted, when it is turned reverſe to its natural poſition with reſpect to other objects which we ſee and compare it with.—If we lay hold of an upright ſtick in the dark, we can tell which is the upper or lower part of it, by moving our hand downward or upward; and know very well that we cannot feel the upper end by moving our hand downward. In the ſame manner we find by experience, that upon directing our eyes towards a tall object, we cannot ſee its top by turning our eyes downward, nor its foot by turning our eyes upward; but muſt trace the object the ſame way by the eye to ſee it from head to foot, as we do by the hand to feel it; and as the judgement is informed by the motion of the hand in one caſe, ſo it is alſo by the motion of the eye in the other.

In fig. 9. is exhibited the manner of ſeeing the ſame object ABC, by both the eyes D and E at once. Fig. 9.

135 An object when viewed with both eyes does not appear double, becauſe the optic nerve is inſenſible of light.

When any part of the image $c\,b\,a$ falls upon the optic nerve L, the correſponding part of the object becomes inviſible. On this account, the optic nerve is wiſely placed, not in the middle of the bottom of the eye, but towards the ſide next the noſe; ſo that whatever part of the image falls upon the optic nerve of one eye, may not fall upon the optic nerve of the other. Thus the point a of the image $c\,b\,a$ falls upon the optic nerve of the eye D, but not of the eye E; and the point

Of Vision. *c* falls upon the optic nerve of the eye E, but not of the eye D; and therefore to both eyes taken together, the whole object ABC is visible.

The nearer that any object is to the eye, the larger is the angle under which it is seen, and the magnitude of which it appears. Thus to the eye D, the object ABC is seen under the angle APC; and its image *c b a* is very large upon the retina: but to the eye E, at a double distance, the same object is seen under the angle A*p*C, which is equal only to half the angle APC, as is evident by the figure. The image *c b a* is likewise twice as large in the eye D, as the other image *c b a* is in the eye E. In both these representations, a part of the image falls on the optic nerve, and the object in the corresponding part is invisible.

Plate CCCLXXXI. fig. 1.

As the sense of seeing is allowed to be occasioned by the impulse of the rays from the visible object upon the retina, and thus forming the image of the object upon it, and that the retina is only the expansion of the optic nerve all over the choroides; it should seem surprising, that the part of the image which falls on the optic nerve should render the like part of the object invisible; especially as that nerve is allowed to be the instrument by which the impulse and image are conveyed to the common sensory in the brain.

136 Proved by experiment. Fig. 2.

That part of the image which falls upon the middle of the optic nerve is lost, and consequently the corresponding part of the object is rendered invisible, is plain by experiment. For if a person fixes three patches, A, B, C, (fig. 2.) upon a white wall, at the height of the eye, and at the distance of about a foot from each other, and places himself before them, shutting the right eye, and directing the left towards the patch C, he will see the patches A and C, but the middle patch B will disappear. Or, if he shuts his left eye, and directs the right towards A, he will see both A and C, but B will disappear; and if he directs his eye towards B, he will see both B and A, but not C. For whatever patch is directly opposite to the optic nerve N, vanishes. This requires a little practice; after which he will find it easy to direct his eye so as to lose the sight of whatever patch he pleases.

137 Dispute concerning the seat of vision.

This experiment, first tried by M. Marriotte, occasioned a new hypothesis concerning the seat of vision, which he supposed not to be in the retina, but in the choroides. An improvement on the experiment was afterwards made by M. Picard, who contrived that an object should disappear when both the eyes were kept open. He fastened upon a wall a round white paper, an inch or two in diameter; and by the side of it he fixed two marks, one on the right hand, and the other on the left, each at about two feet distance from the paper, and somewhat higher. He then placed himself directly before the paper, at the distance of nine or ten feet, and putting the end of his finger over against both his eyes, so that the left-hand mark might be hid from the right eye, and the right-hand mark from the left eye. Remaining firm in this posture, and looking steadily, with both eyes, on the end of his finger, the paper which was not at all covered by it would totally disappear. This, he says, is the more surprising, because, without this particular encounter of the optic nerves, where no vision is made, the paper will appear double, as is the case when the finger is not rightly placed.

Of Vision.

M. Marriotte observes, that this improvement on his experiment, by M. Picard, is ingenious, but difficult to execute, since the eyes must be considerably strained in looking at any object so near as four inches; and proposes another not less surprising, and more easy. Place, says he, on a dark ground, two round pieces of white paper, at the same height, and three feet from one another; then stand opposite to them, at the distance of 12 or 13 feet, and hold your thumb before your eyes, at the distance of about eight inches, so that it may conceal from the right eye the paper that is to the left hand, and from the left eye the paper to the right hand. Then, if you look at your thumb steadily with both eyes, you will lose sight of both the papers; the eyes being so disposed, that each of them receives the image of one of the papers upon the base of the optic nerve, while the other is intercepted by the thumb.

M. Le Cat pursued this curious experiment a little farther than M. Marriotte. In the place of the second paper, he fixed a large white board, and observed, that at a proper distance he lost sight of a circular space in the centre of it. He also observed the size of the paper which is thus concealed from the sight, corresponding to several distances, which enabled him to ascertain several circumstances relating to this part of the structure of the eye more exactly than had been done before.

The following is the manner in which this curious experiment is now generally made. Let three pieces of paper be fastened upon the side of a room, about two feet asunder; and let a person place himself opposite to the middle paper, and, beginning near to it, retire gradually backwards, all the while keeping one of his eyes shut, and the other turned obliquely towards that outside paper which is towards the covered eye, and he will find a situation (which is generally at about five times the distance at which the papers are placed from one another), when the middle paper will entirely disappear, while the two outermost continue plainly visible; because the rays which come from the middle paper will fall upon the retina where the optic nerve is inserted.

It is not surprising that M. Marriotte was led, by this remarkable observation, to suspect that the retina was the seat of vision. He not only did so; but, in consequence of attentively considering the subject, a variety of other arguments in favour of the choroides occurred to him, particularly his observation, that the retina is transparent, as well as the crystalline and other humours of the eye, which he thought could only enable it to transmit the rays farther; and he could not persuade himself that any substance could be considered as being the termination of the pencils and the proper seat of vision, at which the rays are not stopped in their progress.

He was farther confirmed in his opinion of the small degree of sensibility in the retina, and of the greater sensibility of the choroides, by observing that the pupil dilates itself in the shade, and contracts itself in a great light; which involuntary motion, he thought, was a clear proof that the fibres of the iris are extremely sensible to the action of light; and this part of the eye is only a continuation of the choroides. He also thought that the dark colour of the choroid coat was intended to make it more susceptible of the impression of light.

M.

M. Pecquet, in anſwer to M. Marriotte's obſervation concerning the tranſparency of the retina, ſays, that it is very imperfectly ſo, reſembling only oiled paper, or the horn that is uſed for lanterns; and beſides, that its whiteneſs demonſtrates it to be ſufficiently opaque for ſtopping the rays of light, as much as is neceſſary for the purpoſe of viſion; whereas, if viſion be performed by means of thoſe rays which are tranſmitted through ſuch a ſubſtance as the retina, it muſt be very indiſtinct. The retina reſembles very much the thin white film which intervenes between the white of an egg and its ſhell.

As to the blackneſs of the choroides, which M. Marriotte thought to be neceſſary for the purpoſe of viſion, M. Pecquet obſerves, that it is not the ſame in all eyes, and that there are very different ſhades of it among the individuals of mankind, as alſo among birds, and ſome other animals, whoſe choroides is generally black; and that in the eyes of lions, camels, bears, oxen, ſtags, ſheep, dogs, cats, and many other animals, that part of the choroides which is the moſt expoſed to light, very often exhibits colours as vivid as thoſe of mother-of-pearl, or of the iris. He admits that there is a defect of viſion at the inſertion of the optic nerve; but he thought that it was owing to the blood-veſſels of the retina, the trunks of which are ſo large in that place as to obſtruct all viſion.

To M. Pecquet's objection, founded on the opacity of the retina, M. Marriotte replies, that there muſt be a great difference betwixt the ſtate of that ſubſtance in in living and dead ſubjects; and as a further proof of the tranſparency of the retina, and the power of the choroides beyond it to reflect light, he ſays, that if a lighted candle be held near to a perſon's eyes, and a dog, at the diſtance of eight or ten ſteps, be made to look at him, he would ſee a bright light in the dog's eyes, which he thought to proceed from the reflection of the light of the candle from the choroides of the dog, ſince the ſame appearance cannot be produced in the eyes of men, or other animals, whoſe choroides is black.

M. Marriotte obſerves, in oppoſition to Pecquet's remark concerning the blood-veſſels of the retina, that they are not large enough to prevent viſion in every part of the baſe of the nerve, ſince the diameter of each of the two veſſels occupies no more than $\frac{1}{5}$th part of it. Beſides, if this were the cauſe of this want of viſion, it would vaniſh gradually, and the ſpace to which it is confined would not be ſo exactly terminated as it appears to be.

We muſt add, that M. Pecquet alſo obſerved, that notwithſtanding the inſenſibility of the retina at the inſertion of the optic nerve when the light is only moderate; yet luminous objects, ſuch as a bright candle placed at the diſtance of four or five paces, do not abſolutely diſappear, in the ſame circumſtances in which a white paper would; for this ſtrong light may be perceived though the picture fall on the baſe of the nerve.

Dr Prieſtley, however, found that a large candle made no impreſſion on that part of his eye, though by no means able to bear a ſtrong light.

The common opinion was alſo favoured by the anatomical deſcription of ſeveral animals by the members of the French academy, and particularly their account of the ſea calf and porcupine; in both of which the optic nerve is inſerted in the very axis of the eye, exactly oppoſite to the pupil, which was thought to leave no room to doubt, but that in theſe animals the retina is perfectly ſenſible to the impreſſion of light at the inſertion of the nerve.

M. De la Hire took part with M. Pecquet, arguing in favour of the retina from the analogy of the ſenſes, in all of which the nerves are the proper ſeat of ſenſation. This philoſopher, however, ſuppoſed that the choroid coat receives the impreſſions of images, in order to tranſmit them to the retina.

M. Perrault alſo took the part of M. Pecquet againſt M. Marriotte, and in M. Perrault's works we have ſeveral letters that paſſed between theſe two gentlemen upon this ſubject.

This diſpute was revived by an experiment of M. Mery, recorded in the Memoirs of the French Academy for 1704. He plunged a cat in water, and expoſing her eye to the ſtrong light of the ſun, obſerved that the pupil was not at all contracted by it; whence he concluded, that the contraction of the iris is not produced by the action of the light. For he contended that the eye receives more light in this ſituation than in the open air. At the ſame time he thought he obſerved that the retina of the cat's eye was tranſparent, and that he could ſee the opaque choroides beyond it: from which he concludes, that the choroides is the ſubſtance intended to receive the rays of light, and to be the chief inſtrument of viſion. But M. De la Hire, in oppoſition to this argument of M. Mery, endeavours to ſhow that fewer rays enter the eye under water, and that in thoſe circumſtances it is not ſo liable to be affected by them. Beſides, it is obvious, that the cat muſt be in great terror in this ſituation; and being an animal that has a very great voluntary power over the muſcles of the iris, and being now extremely attentive to every thing about her, ſhe might keep her eye open notwithſtanding the action of the light upon it, and though it might be very painful to her. We are informed, that when a cat is placed in a window through which the ſun is ſhining, and conſequently her iris nearly cloſed, if ſhe hear a ruſtling, like that which is made by a mouſe, on the outſide of the window, ſhe will immediately open her eyes to their greateſt extent, without in the leaſt turning her face from the light.

M. Le Cat took the ſide of M. Marriotte in this controverſy, it being peculiarly agreeable to his general hypotheſis, viz. that the pia mater, of which the choroides is a production, and not the nerves themſelves, is the proper inſtrument of ſenſation. He thought that the change which takes place in the eyes of old people (the choroides growing leſs black with age) favoured his hypotheſis, as they do not ſee with the ſame diſtinctneſs as young perſons. M. Le Cat ſuppoſed that the retina anſwers a purpoſe ſimilar to that of the ſcarf-ſkin, covering the papillæ pyramidales, which are the immediate organs of feeling, or that of the porous membrane which covers the glandulous papillæ of the tongue. The retina, he ſays, receives the impreſſion of light, moderates it, and prepares it for its proper organ, but is not itſelf ſenſible of it.

It muſt be obſerved, that M. Le Cat had diſcovered that the pia mater, after cloſely embracing the optic nerve, at its entrance into the eye, divides into two branches, one of which cloſely lines the cornea, and at length is loſt in it, while the ſecond branch forms what is is called the *choroides*, or *uvea*. He alſo ſhowed that the ſclerotic coat is an expanſion of the dura mater; and he ſent diſſections of the eye to the Royal Academy of Sciences in 1739, to prove theſe aſſertions, and ſeveral others contrary to the opinions of the celebrated Winſlow, which he had advanced in his *Traité de Sens*.

To theſe arguments in favour of the choroides, we may add the following given by Mr Michell.

In order that viſion be diſtinct, the pencils of rays which iſſue from the ſeveral points of any object, muſt be collected either accurately, or at leaſt very nearly, to correſponding points in the eye, which can only be done upon ſome uniform ſurface. But the retina being of a conſiderable thickneſs, and the whole of it being uniformly nervous, and at leaſt nearly, if not perfectly, tranſparent, preſents no particular ſurface; ſo that, in whatever part of it the pencils be ſuppoſed to have their foci, the rays belonging to them will be ſeparated from one another, either before or after they arrive there, and conſequently viſion would be confuſed.

If we ſuppoſe the ſeat of viſion to be at the interior ſurface of the retina, and the images of objects to be formed by direct rays, a conſiderable degree of confuſion could not but ariſe from the light reflected by the choroides, in thoſe animals in which it is white, or coloured. On the other hand, it would be impoſſible that viſion ſhould be performed at this place by light reflected from the choroides, becauſe in many animals it is perfectly black; and yet ſuch animals ſee even more diſtinctly than others.

If the ſeat of viſion be at the farther ſurface of the retina, and if viſion be performed by direct rays, a white choroid coat could be of no uſe; and if it were by reflected rays, a black one could not anſwer the purpoſe.

It is likewiſe an argument in favour of the choroides being the organ of viſion, that it is a ſubſtance which receives a more diſtinct impreſſion from the rays of light than any other membrane in any part of the animal ſyſtem, excepting, perhaps, that white cuticle which lies under the ſcales of fiſhes; whereas the retina is a ſubſtance on which the light makes an exceedingly faint impreſſion, and perhaps no impreſſion at all; ſince light, in paſſing out of one tranſparent medium into another immediately contiguous to it, ſuffers no refraction or reflection, nor are any of the rays abſorbed, unleſs there is ſome difference in the refracting power of the two media, which probably is not the caſe between the retina and the vitreous humour which is in contact with it: And wherever the light is not affected by the medium on which it falls, we can hardly ſuppoſe the medium to receive any impreſſion from the light, the action being probably always mutual and reciprocal.

Beſides, the retina is ſo ſituated, as to be expoſed to many rays beſides thoſe which terminate in it, and which, therefore, cannot be ſubſervient to viſion, if it be performed there. Now this is not the caſe with the choroides, which is in no ſhape tranſparent, and has no reflecting ſubſtance beyond it.

It is, beſides, peculiarly favourable to the opinion of Marriotte, that we can then ſee a ſufficient reaſon for the diverſity of its colour in different animals, according as they are circumſtanced with reſpect to viſion. In all terreſtrial animals, which uſe their eyes by night, the choroides is either of a bright white, or of ſome very vivid colour, which reflects the light very ſtrongly. On this account viſion may be performed with leſs light, but it cannot be with great diſtinctneſs, the reflection of the rays doubling their effect, ſince it muſt extend over ſome ſpace, all reflection being made at a diſtance from the reflecting body. Beſides, the choroides in brutes is not in general perfectly white, but inclined to blue; and is therefore, probably, better adapted to ſee by the fainter coloured light, which chiefly prevails in the night; and we would add, is on the ſame account more liable to be ſtrongly impreſſed by the colours to which they are chiefly expoſed.

On the other hand, the choroides of birds in general, eſpecially eagles, hawks, and other birds of prey, is black; by which means they are able to ſee with the greateſt diſtinctneſs, but only in bright day light. The owl, however, ſeeking her food by night, has the choroides white, like that of a cat. In the eyes of man, which are adapted to various uſes, the choroides is neither ſo black as that of birds, nor ſo white as that of thoſe animals who make the greateſt uſe of their eyes in the night.

As to a third hypotheſis, which is in effect that of M. De la Hire, and which makes both the retina and the choroides equally neceſſary to viſion, and ſuppoſes it to be performed by the impreſſion of light on the choroides communicated to the retina; Mr Michell obſerves, that the perceptions can hardly be ſuppoſed to be ſo acute, when the nerves do not receive the impreſſions immediately, but only after they have been communicated to another ſubſtance. Beſides, it muſt be more natural to ſuppoſe, that, when the principal impreſſion is made upon the choroides, it is communicated to the brain by its own nerves, which are ſufficient for the purpoſe.

138 Dimenſions of the ſpot in the eye where there is no viſion. Plate CCCLXXXI. Fig. 3.

The dimenſions and preciſe form of the ſpot in the eye in which there is no viſion, were more accurately calculated by Daniel Bernouilli, in the following manner. He placed a piece of money, O, upon the floor; and then ſhutting one of his eyes, and making a pendulum to ſwing, ſo that the extremity of it might be nearly in the line AO, he obſerved at what place C it began to be inviſible, and where it again emerged into view at A. Raiſing the pendulum higher and lower, he found other points, as H, N, P, G, B, at which it began to be inviſible; and others, as M, L, E, A, at which it began to be viſible again; and drawing a curve through them, he found that it was elliptical; and, with reſpect to his own eye, the dimenſions of it were as follow; OC was 23, AC 10, BD 3, DH 13, and EG 14; ſo that the centre being at F, the greater axis was to the leſs as 8 to 7.

From theſe *data* the plane on which the figure was drawn being obliquely ſituated with reſpect to the eye, he found, that the place in the eye that correſponded to it was a circle, the diameter of which was a ſeventh part of the diameter of the eye, the centre of it being 27 parts of the diameter from the point oppoſite to the pupil, a little above the middle. In order, therefore, that this ſpace in which there is no viſion may be as ſmall as poſſible, it is neceſſary that the nerve ſhould enter the eye perpendicularly, and that both this end, and alſo its entering the eye at a diſtance from its axis, are gained by the particular manner in which the two optic nerves

Of Vision. nerves unite and become ſeparate again, by croſſing one another.

In ſupport of one of the obſervations of Mr Michell, Dr Prieſtley obſerves, that Aquapendente mentions the caſe of a perſon at Piſa, who could ſee very well in the night, but very little or none at all in the day time. This is alſo ſaid to be the caſe with thoſe white people among the blacks of Africa, and the inhabitants of the iſthmus of America, who, from this circumſtance, are called *moon-eyed*. Dr Prieſtley thinks it probable that their choroides is not of a dark colour, as it is in others of the human ſpecies; but white or light-coloured, as in thoſe animals which have moſt occaſion for their eyes in the night.

139 Arguments for the retina's being the ſeat of viſion.

Dr Porterfield obſerves, that the reaſon why there is no viſion at the entrance of the optic nerve into the eye, may be its want of that ſoftneſs and delicacy which it has when it is expanded upon the choroides; and that, in thoſe animals in which that nerve is inſerted in the axis of the eye, it is obſerved to be equally delicate, and therefore probably equally ſenſible, in that place as in any other part of the retina. In general, the nerves, when embraced by their coats, have but little ſenſibility in compariſon of what they are endued with when they are diveſted of them, and unfolded in a ſoft and pulpy ſubſtance.

Haller obſerves, that the choroides cannot be univerſally the ſeat of viſion, becauſe, ſometimes in men and birds, but eſpecially in fiſhes, it is covered internally with a black mucus, through which the rays cannot penetrate. This writer ſpeaks of a fibrous membrane in the retina diſtinct from its pulpy ſubſtance. On theſe fibres, he conjectures, that the images of objects are painted.

M. De la Hire's argument in favour of the retina, from the analogy of the ſenſes, is much ſtrengthened by conſidering that the retina is a large nervous apparatus, immediately expoſed to the impreſſion of light; whereas the choroides receives but a ſlender ſupply of nerves, in common with the ſclerotica, the conjunctiva, and the eyelids, and that its nerves are much leſs expoſed to the light than the naked fibres of the optic nerve.

That the optic nerve is of principal uſe in viſion, is farther probable from ſeveral phenomena attending ſome of the diſeaſes of the eye. When an amauroſis has affected one eye only, the optic nerve of that eye has been found manifeſtly altered from its ſound ſtate. Dr Prieſtley was preſent when Mr Hey examined the brain of a young girl, who had been blind of one eye, and ſaw that the optic nerve belonging to it was conſiderably ſmaller than the other; and he informed him, that upon cutting into it it was much harder, and cineritious. Morgagni mentions two caſes, in one of which he found the optic nerves ſmaller than uſual, and of a cineritious colour, when, upon inquiry, he was informed that the perſon had not been blind, though there might have been ſome defect in the ſight of one of the eyes. In the other caſe, only one of the optic nerves was affected in that manner, and the eye itſelf was in other reſpects very perfect. Here, alſo, he was expreſsly told, that the perſon was not blind of that eye.

Beſides, as the optic nerve is ſolely ſpent in forming the retina, ſo no function of the eye not immediately ſubſervient to viſion, is affected by an amauroſis. On the contrary, thoſe nerves which go to the choroides are found to retain, in this diſeaſe, their natural influence. The iris will contract in a recent gutta ſerena of one eye, if the other remains ſound, and is ſuddenly expoſed to a ſtrong light. The ſclerotica, conjunctiva, and eyelids, which receive their nerves from the ſame branches as the choroides, retain their ſenſibility in this diſorder.

The manner in which perſons recover from an amauroſis, favours the ſuppoſition of the ſeat of viſion being in the retina: ſince thoſe parts which are the moſt diſtant from the inſertion of the nerve recover their ſenſibility the ſooneſt, being in thoſe places the moſt pulpy and ſoft; whereas there is no reaſon to think that there is any difference in this reſpect in the different parts of the choroides. Mr Hey has been repeatedly informed, by perſons labouring under an imperfect amauroſis, or gutta ſerena, that they could not, when looking at any object with one eye, ſee it ſo diſtinctly when it was placed in the axis of the eye, as when it was ſituated out of the axis. And thoſe perſons whom he had known to recover from a perfect amauroſis, firſt diſcovered the objects whoſe images fell upon that part of the retina which is at the greateſt diſtance from the optic nerve.

We ſhall conclude theſe remarks with obſerving, that if the retina be as tranſparent as it is generally repreſented to be, ſo that the termination of the pencils muſt neceſſarily be either upon the choroides, or ſome other opaque ſubſtance interpoſed between it and the retina, the action and reaction occaſioned by the rays of light being at the common ſurface of this body and the retina, both theſe mediums (ſuppoſing them to be equally ſenſible to light) may be equally affected; but the retina, being naturally much more ſenſible to this kind of impreſſion, may be the only inſtrument by which the ſenſation is conveyed to the brain, though the choroides, or the black ſubſtance with which it is ſometimes lined, may alſo be abſolutely neceſſary to viſion. This is not far from the hypotheſis of M. de la Hire, and will completely account for the entire defect of viſion at the inſertion of the optic nerve.

140 Of bright and obſcure, diſtinct and indiſtinct viſion.

Viſion is diſtinguiſhed into *bright* and *obſcure*, *diſtinct* and *indiſtinct*.—It is ſaid to be *bright*, when a ſufficient number of rays enter the pupil at the ſame time; *obſcure*, when too few. It is *diſtinct* when each pencil of rays is collected into a focus exactly upon the retina; *indiſtinct*, when they meet before they come at it, or when they would paſs it before they meet; for, in either of theſe laſt caſes, the rays flowing from different parts of the object will fall upon the ſame part of the retina, which muſt neceſſarily render the image indiſtinct.—Now, that objects may appear with a due brightneſs, whether more or fewer rays proceed from them, we have a power of contracting or dilating the pupil, by means of the muſcular fibres of the iris, in order to take in a greater or ſmaller number of rays. But this power has its limits. In ſome animals it is much greater than in others; particularly in ſuch as are obliged to ſeek their food by night as well as by day, as in cats, &c.

141 Of diſtinct viſion at different diſtances.

In order that the rays be collected into points exactly upon the retina, that is, in order that objects may appear *diſtinct*, whether they be nearer or farther off, i. e. whether the rays proceeding from them diverge more or leſs, Of Vision. lefs, fome change muft neceffarily take place in the eye. The nature of this change has been a fubject of great difpute among philofophers. While fome have maintained, that the eye accommodates itfelf to different diftances, by the mufcular power of the ciliary ligament, which makes the cryftalline lens approach to, or recede from, the retina; others are of opinion, that the form of the cryftalline is altered by the ciliary ligament, or by the mufcular power of the laminæ of which it is compofed. M. de la Hire fuppofes, that the eye is adapted to various diftances by the contraction and dilatation of the pupil; and Dr Monro imagines, that its effect is produced by the preffure of the orbicular mufcles upon the upper and under parts of the cornea, or by the action of the recti mufcles, which elongate the axis of the eye, by preffing chiefly upon the fides of the eyeballs.—This fubject has lately been accurately examined by Mr Ramfden, and Mr Everard Home, who found, that the adjuftment of the eye is effected by three changes in the organ: 1. By an increafe of curvature in the cornea, occafioned by the action of the recti mufcles, which produces $\frac{1}{4}$ of the effect. 2. By an elongation of the eyeball; and, 3. By a motion of the cryftalline lens.

142 Of fhort-fighted and long-fighted people.

In thofe eyes where the cornea is very protuberant, the rays of light fuffer a confiderable refraction at their entrance into the aqueous humour, and are therefore collected into a focus before they fall upon the retina, unlefs the object be placed very near, fo that the rays which enter the eye may have a confiderable degree of divergency. People that have fuch eyes are faid to be *purblind*. Now, fince the nearer an object is to the eye, the greater is its image, thefe people can fee much fmaller objects than others, as they fee much nearer ones with the fame diftinctnefs; and their fight continues good longer than that of other people, becaufe the cornea, as they grow old, becomes lefs protuberant, from the want of that redundancy of humours with which they were filled before. On the contrary, old men having the cornea of their eyes too flat, for want of a fufficient quantity of the aqueous humour, if the rays diverge too much before they enter the eye, they cannot be brought to a focus when they reach the retina: on which account thofe people cannot fee diftinctly, unlefs the object be fituated at a greater diftance from the eye than is required for thofe whofe eyes are of a due form. The latter require the affiftance of convex glaffes to make them fee objects diftinctly; the former of concave ones. For if either the cornea *a b c*, (fig. 4). or cryftalline humour *e*, or both of them, be too flat, as in the eye A, their focus will not be on the retina as at A, where it ought to be, in order to render vifion diftinct; but beyond the eye, as at *f*. This is remedied by placing a convex glafs *g h* before the eye, which makes the rays converge fooner, and forms the image exactly on the retina at *d*. Again, If either the cornea, or cryftalline humour, or both of them, be too convex, as in the eye B, the rays that enter it from the object C will be converged to a focus in the vitreous humour, as at *f*; and by diverging from thence to the retina, will form a very confufed image upon it; fo that the obferver will have as confufed a view of the object as if his eye had been too flat. This inconvenience is remedied by placing a concave glafs *g h* before the eye; which glafs, by caufing the rays to diverge between it and the eye, lengthens the focal diftance, and makes the rays unite at the retina, and form a diftinct image of the object.

Plate CCLXXXI. Fig. 4.

143 Of the leaft angle of vifion.

Such eyes as are of a proper convexity, cannot fee any object diftinctly at lefs diftance than fix inches; and there are numberlefs objects too fmall to be feen at that diftance, becaufe they cannot appear under any fenfible angle.—Concerning the leaft angle under which any object is vifible, there was a debate between Dr Hooke and Hevelius. The former afferted that no object could well be feen if it fubtended an angle lefs than one minute; and, if the object be round, as a black circular fpot upon a white ground, or a white circle upon a black ground, it follows, from an experiment made by Dr Smith, that this is near the truth; and from this he calculates, that the diameter of the picture of fuch leaft vifible point upon the retina is the 8000th part of an inch; which he therefore calls a *fenfible point of the retina*. On the other hand, Mr Courtivron found, by experiment, that the fmalleft angle of vifion was 40 feconds. According to Dr Jurin, there are cafes in which a much fmaller angle than one minute can be difcerned by the eye; and he obferves, that in order to our perceiving any impreffion upon our fenfes, it muft either be of a certain degree of force, or of a certain degree of magnitude. For this reafon, a ftar, which appears only as a lucid point through a telefcope fubtending not fo much as an angle of one fecond, is vifible to the eye; though a white or black fpot of 25 or feconds, is not perceptible. Alfo a line of the fame breadth with the circular fpot will be vifible at fuch a diftance as the fpot is not to be perceived at; becaufe the quantity of impreffion from the line is much greater than that from the fpot; and a longer line is vifible at a greater diftance than a fhorter one of the fame breadth. He found by experience, that a filver wire could be feen when it fubtended an angle of three feconds and a half; and that a filk thread could be feen when it fubtended an angle of two feconds and a half.

144 Lines can be feen under fmaller angles than fpots, and why.

This greater vifibility of a line than of a fpot feems to arife only from the greater quantity of the impreffion; but without the limits of perfect vifion, Dr Jurin obferves, that another caufe concurs, whereby the difference of vifibility between the fpot and the line is rendered much more confiderable. For the impreffion upon the retina made by the line is then not only much greater, but alfo much ftronger, than that of the fpot; becaufe the faint image, or penumbra, of any one point of the line, when the hole is placed beyond the limits of diftinct vifion, will fall within the faint image of the next point, and thereby much increafe the light that comes from it.

In fome cafes Dr Jurin found the caufe of indiftinct vifion to be the unfteadinefs of the eye; as our being able to fee a fingle black line upon a white ground or a fingle white line upon a black ground, and not a white line between two black ones on a white ground. In viewing either of the former objects, if the eye be imperceptibly moved, all the effect will be, that the object will be painted upon a different part of the retina; but wherever it is painted, there will be but one picture, fingle and uncompounded with any other. But in viewing the other, if the eye fluctuate ever fo little, the image of one or other of the black lines will be fo fhifted to that part of the retina which was before poffeffed by

Of Vision. by the white line; and this must occasion such a dazzling in the eye, that the white line cannot be distinctly perceived, and distinguished from the black lines; which, by a continual fluctuation, will alternately occupy the space of the white line, whence must arise an appearance of one broad dark line, without any manifest separation.

By trying this experiment with two pins of known diameters, set in a window against the sky light, with a space between them equal in breadth to one of the pins, he found that the distance between the pins could hardly be distinguished when it subtended an angle of less than 40 seconds, though one of the pins alone could be distinguished when it subtended a much less angle. But though a space between two pins cannot be distinguished by the eye when it subtends an angle less than 40 seconds, it does not follow that the eye must necessarily commit an error of 40 seconds in estimating the distance between two pins when they are much farther from one another. For if the space between them subtend an angle of one minute, and each of the pins subtend an angle of four seconds, which is greater than the least angle the eye can distinguish, it is manifest that the eye may judge of the place of each pin within two seconds at the most; and consequently the error committed in taking the angle between them cannot at the most exceed four seconds, provided the instrument be sufficiently exact. And yet, says he, upon the like mistake was founded the principal objection of Dr Hooke against the accuracy of the celestial observations of Hevelius.

A black spot upon a white ground, or a white spot upon a black ground, he says, can hardly be perceived by the generality of eyes when it subtends a less angle than one minute. And if two black spots be made upon white paper, with a space between them equal in breadth to one of their diameters, that space is not to be distinguished, even within the limits of perfect vision, under so small an angle as a single spot of the same size. To see the two spots distinctly, therefore, the breadth of the space between them must subtend an angle of more than a minute. It would be difficult, he says, to make this experiment accurately, within the limits of perfect vision; because the objects must be extremely small: but by a rude trial, made with square bits of white paper, placed upon a black ground, he judged, that the least angle under which the interval of two objects could be perceived, was at least a fourth part greater than the least angle under which a single object can be perceived. So that an eye which cannot perceive a single object under a smaller angle than one minute, will not perceive the interval between two such objects under a less angle than 75 seconds.

Without the limits of perfect vision, the distance at which a single object ceases to be perceptible will be much greater in proportion than the distance at which a space of equal breadth between two such objects ceases to be perceptible. For, without these limits, the image of each of the objects will be attended with a penumbra, and the penumbra of the two near objects will take up part of the space between them, and thus render it less perceptible; but the penumbra will add to the breadth of the single object, and will thereby make it more perceptible, unless its image be very faint. Upon the same principles he likewise accounts for the radiation of the stars, whereby the light seems to project from them different ways at the same time. Of Vision.

Mr Mayer made many experiments in order to ascertain the smallest angle of vision in a variety of respects. He began with observing at what distance a black spot was visible on white paper; and found, that when it could barely be distinguished, it subtended an angle of about 34 seconds. When black lines were disposed with intervals broader than themselves, they were distinguished at a greater distance than they could be when the objects and the intervals were equal in breadth. In all these cases it made no difference whether the objects were placed in the shade or in the light of the sun; but when the degrees of light were small, their differences had a considerable effect, though by no means in proportion to the differences of the light. For if an object was illuminated to such a degree as to be just visible at the distance of nine feet, it would be visible at the distance of four feet, though the light was diminished above 160 times. It appeared in the course of these experiments, that common daylight is, at a medium, equal to that of 25 candles placed at the distance of one foot from the object.

145 Of single vision with two eyes.

As an image of every visible object is painted on the retina of each of our eyes, it thence becomes a natural question, Why we do not see every thing double? It was the opinion of Sir Isaac Newton and others, that objects appear single, because the two optic nerves unite before they reach the brain. But Dr Porterfield shows, from the observation of several anatomists, that the optic nerves do not mix, or confound their substance, being only united by a close cohesion; and objects have appeared single where the optic nerves were found to be disjoined.

146 Solutions of this difficulty by Dr Briggs.

Dr Briggs supposed that single vision was owing to the equal tension of the corresponding parts of the optic nerves, whereby they vibrated in a synchronous manner. But, besides several improbable circumstances in this account, Dr Porterfield shows that facts do by no means favour it.

147 Dr Porterfield.

To account for this phenomenon, this ingenious writer supposes, that by an original law in our natures, we imagine objects to be situated somewhere in a right line drawn from the picture of it upon the retina, through the centre of the pupil. Consequently, the same object appearing to both eyes to be in the same place, the mind cannot distinguish it into two. In answer to an objection to this hypothesis, from objects appearing double when one eye is distorted, he says the mind mistakes the position of the eye, imagining that it had moved in a manner corresponding to the other, in which case the conclusion would have been just.

This principle, however, has been thought sufficient to account for this appearance. Originally, every object, making two pictures, is imagined to be double; but by degrees, we find, that when two corresponding parts of the retina are impressed, the object is but one; but if those corresponding parts be changed, by the distortion of one of the eyes, the object must again appear double as at the first. This has been thought verified by Mr Chefelden; who informs us, that a gentleman, who from a blow on his head had one eye distorted, found every object to appear double; but by degrees the

Of Vision. the most familiar ones came to appear single again, and in time all objects did so, without any amendment of the distortion.

148 Dr Reid, and On the other hand, Dr Reid is of opinion, that the correspondence of the centres of the two eyes, on which single vision depends, does not arise from custom, but from some natural constitution of the eye and of the mind. He makes several just objections to the case of Mr Forster, recited by Dr Smith and others; and thinks that the case of the young man couched by Cheselden, who saw singly with both eyes immediately upon receiving his sight, is nearly decisive in proof of his supposition. He also found that three young gentlemen, whom he endeavoured to cure of squinting, saw objects singly, as soon as ever they were brought to direct the centres of both their eyes to the same object, though they had never been used to do so from their infancy; and he observes, that there are cases, in which, notwithstanding the fullest conviction of an object being single, no practice of looking at it will ever make it appear so, as when it is seen through a multiplying glass.

To all these solutions of the difficulty respecting single vision by both eyes, objections have been lately made which seem insurmountable. By judicious experiments, Dr Wells has shown, that it is neither by custom alone, nor by the original property of the eyes alone, that objects appear single; and having demolished the theories of others, he thus endeavours to account for the phenomenon.

149 Dr Wells. "The visible place of an object being composed of its visible distance and visible direction, to show how it may appear the same to both eyes, it will be necessary (says he *) to explain in what manner the distance and direction, which are perceived by one eye, may coincide with those which are perceived by the other." With respect to visible distance, the author's opinion seems not to differ from that which we have stated elsewhere (see METAPHYSICS, N° 49, 50.); and therefore we have to attend only to what he says of visible direction.

* *Essay on single Vision, &c.*

When a small object is so placed with respect to either eye, as to be seen more distinctly than in any other situation, our author says that it is then in the *optic axis*, or the axis of that eye. When the two optic axes are directed to a small object not very distant, they may be conceived to form two sides of a triangle, of which the base is the interval between the points of the corners where the axes enter the eyes. This base he called the *visual base*; and a line drawn from the middle of it to the point of intersection of the optic axis he calls the *common axis*. He then proceeds to show, that objects *really situated* in the *optic* axis do not *appear* to be in that line, but in the *common axis*.

Every person (he observes) knows, that if an object be viewed through two small holes, one applied to each eye, the two holes appear but as one. The theories hitherto invented afford two explanations of this fact. According to Aguilonius, Dechales, Dr Porterfield, and Dr Smith, the two holes, or rather their borders, will be seen in the same place as the object viewed through them, and will consequently appear united, for the same reason that the object itself is seen single. But whoever makes the experiment will distinctly perceive, that the united hole is much nearer to him than the object; not to mention, that any fallacy on this head might be corrected by the information from the sense of touch, that the card or other substance in which the holes have been made is within an inch or less of our face. The other explanation is that furnished by the theory of Dr Reid. According to it, the centres of the retinas, which in this experiment receive the pictures of the holes, will, by an original property, represent but one. This theory, however, though it makes the two holes to appear one, does not determine where this one is to be seen. It cannot be seen in only one of the perpendiculars to the images upon the retinas, for no reason can be given why this law, of visible direction, which Dr Reid thinks established beyond dispute, if it operates at all, should not operate upon both eyes at the same time; and if it be seen by both eyes in such lines, it must appear where those lines cross each other, that is, in the same place with the object viewed through the holes, which, as I have already mentioned, is contrary to experience. Nor is it seen in any direction, the consequence of a law affecting both eyes considered as one organ, but suspended when each eye is used separately. For when the two holes appear one, if we pay attention to its situation, and then close one eye, the truly single hole will be seen by the eye remaining open in exactly the same direction as the apparently single hole was by both eyes.

"Hitherto I have supposed the holes almost touching the face. But they have the same unity of appearance, in whatever parts of the optic axes they are placed; whether both be at the same distance from the eyes, or one be close to the eye in the axis of which it is, and the other almost contiguous to the object seen through them. If a line, therefore, be drawn from the object to one of the eyes, it will represent all the real or tangible positions of the hole, which allow the object to be seen by that eye, and the whole of it will coincide with the optic axis. Let a similar line be drawn to the other eye, and the two must appear but as one line; for if they do not, the two holes in the optic axes will not, at every distance, appear one, whereas experiments prove that they do. This united line will therefore represent the visible direction of every object situated in either of the optic axes. But the end of it, which is toward the face, is seen by the right eye to the left, and by the left eye as much to the right. It must be seen then in the middle between the two, and consequently in the common axis. And as its other extremity coincides with the point where the optic axes intersect each other, the whole of it must lie in the common axis. Hence the truth of the proposition is evident, that objects situated in the optic axis, do not appear to be in that line, but in the common axis.

He then proves by experiments, that objects situated in the common axis do not *appear* to be in that line, but in the axis of the eye by which they are not seen: that is, an object situated in the common axis appears to the right eye in the axis of the left, and *vice versa*. His next proposition, proved likewise by experiments, is, that "objects, situated in any line drawn through the mutual intersection of the optic axes to the visual base, do not appear to be in that line, but in another, drawn through the same intersection, to a point in the visual base distant half this base from the similar extremity of the former line towards the left, if the objects be seen

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ſeen by the right eye, but towards the right if ſeen by the left eye."

From theſe propoſitions he thus accounts for ſingle viſion by both eyes. "If the queſtion be concerning an object at the concourſe of the optic axes, it is ſeen ſingle, becauſe its two ſimilar appearances, in regard to ſize, ſhape, and colour, are ſeen by both eyes in one and the ſame direction, or if you will, in two directions, which coincide with each other through the whole of their extent. It therefore matters not whether the diſtance be truly or falſely eſtimated; whether the object be thought to touch our eyes, or to be infinitely remote. And hence we have a reaſon, which no other theory of viſible direction affords, why objects appeared ſingle to the young gentleman mentioned by Mr Cheſelden, immediately after his being couched, and before he could have learned to judge of diſtance by ſight.

"When two ſimilar objects are placed in the optic axes, one in each, at equal diſtances from the eyes, they will appear in the ſame place, and therefore one, for the ſame reaſon that a truly ſingle object, in the concourſe of the optic axes, is ſeen ſingle.

"To finiſh this part of my ſubject, it ſeems only neceſſary to determine, whether the dependence of viſible direction upon the actions of the muſcles of the eyes be eſtabliſhed by nature, or by cuſtom. But facts are here wanting. As far as they go, however, they ſerve to prove that it ariſes from an original principle of our conſtitution. For Mr Cheſelden's patient ſaw objects ſingle, and conſequently in the ſame directions with both eyes, immediately after he was couched; and perſons affected with ſquinting from their earlieſt infancy ſee objects in the ſame directions with the eye they have never been accuſtomed to employ, as they do with the other they have conſtantly uſed."

150 Objects ſeen with both eyes appear brighter than when ſeen with one.

We are indebted to Dr Jurin for the following curious experiments, to determine whether an object ſeen by both eyes appears brighter than when ſeen with one only.

He laid a ſlip of clean white paper directly before him on a table, and applying the ſide of a book cloſe to his right temple, ſo that the book was advanced conſiderably farther forward than his face, he held it in ſuch a manner, as to hide from his right eye that half of the paper which lay to his left hand, while the left half of the paper was ſeen by both eyes, without any impediment.

Then looking at the paper with both eyes, he obſerved it to be divided, from the top to the bottom, by a dark line, and the part which was ſeen with one eye only was manifeſtly darker than that which was ſeen with both eyes; and, applying the book to his left temple, he found, by the reſult of the experiment, that both his eyes were of equal goodneſs.

He then endeavoured to determine the exceſs of this brightneſs; and comparing it with the appearance of an object illuminated partly by one candle and partly by two, he was ſurpriſed to find that an object ſeen with two eyes is by no means twice as luminous as when it is ſeen with one; and, after a number of trials, he found, that when one paper was illuminated by a candle placed at the diſtance of three feet, and another paper by the ſame candle at the ſame diſtance, and by another candle at the diſtance of 11 feet, the former ſeen by both eyes, and the latter with one eye only, appeared to be of equal whiteneſs; ſo that an object ſeen with both eyes appears brighter than when it is ſeen with one only by about a 13th part.

He then proceeded to inquire, whether an object ſeen with both eyes appears larger than when ſeen with one; but he concluded that it did not, except on account of ſome particular circumſtances, as in the caſe of the binocular teleſcope and the concave ſpeculum.

M. du Tour maintains, that the mind attends to no more than the image made in one eye at a time; and produces ſeveral curious experiments in favour of this hypotheſis, which had alſo been maintained by Kepler and almoſt all the firſt opticians. But, as M. Buffon obſerves, it is a ſufficient anſwer to this hypotheſis, however ingeniouſly it may be ſupported, that we ſee more diſtinctly with two eyes than with one; and that when a round object is near us, we ſee more of the ſurface in one caſe than in the other.

With reſpect to ſingle viſion with two eyes, Dr Hartley obſerves, that it deſerves particular attention, that the optic nerves of men, and ſuch other animals as look the ſame way with both eyes, unite in the *cella turcica* in a ganglion, or little brain, as one may call it, peculiar to themſelves; and that the aſſociations between ſynchronous impreſſions on the two retinas muſt be made ſooner and cemented ſtronger on this account: alſo that they ought to have a much greater power over one another's images, than in any other part of the body. And thus an impreſſion made on the right eye alone, by a ſingle object, may propagate itſelf into the left, and there raiſe up an image almoſt equal in vividneſs to itſelf; and conſequently when we ſee with one eye only, we may, however, have pictures in both eyes.

A curious deception in viſion, ariſing from the uſe of both eyes, was obſerved and accounted for by Dr Smith. It is a common obſervation, he ſays, that objects ſeen with both eyes appear more vivid and ſtronger than they do to a ſingle eye; eſpecially when both of them are equally good. A perſon not ſhort-ſighted may ſoon be convinced of this fact, by looking attentively at objects that are pretty remote, firſt with one eye, and then with both. This obſervation gave occaſion to the conſtruction of the binocular teleſcope, in the uſe of which the phenomenon is ſtill more ſtriking.

Beſides this, Dr Smith obſerves, that there is another phenomenon obſervable with this inſtrument, which is very remarkable. In the foci of the two teleſcopes there are two equal rings, as uſual, which terminate the pictures of the objects there formed, and conſequently the viſible area of the objects themſelves. Theſe equal rings, by reaſon of the equal eye-glaſſes, appear equal and equidiſtant when ſeen ſeparately by each eye; but when they are ſeen with both eyes, they appear much larger, and more diſtant alſo; and the objects ſeen through them alſo appear much larger, though circumſcribed by their united rings, in the ſame places as when they were ſeen ſeparately.

He obſerves that the phenomenon of the enlarged circle of the viſible area in the binocular teleſcope, may be ſeen very plainly in looking at diſtant objects through a pair of ſpectacles, removed from the eyes about four or five inches, and held ſteady at that diſtance. The two innermoſt of the four apparent rings, which hold the glaſſes, will then appear united in one larger and more

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more distant ring than the two outermost, which will hardly be visible unless the spectacles be farther removed.

A curious circumstance relating to the effect of one eye upon the other, was noticed by M. Æpinus, who observed, that, when he was looking through a hole made in a plate of metal, about the 10th part of a line in diameter, with his left eye, both the hole itself appeared larger, and also the field of view seen through it was more extended, whenever he shut his right eye; and both these effects were more remarkable when that eye was covered with his hand. He found considerable difficulty in measuring this augmentation of the apparent diameter of the hole, and of the field of view; but at length he found, that, when the hole was half an inch, and the tablet which he viewed through it was three feet from his eye, if the diameter of the field when both his eyes were open was 1, it became $1\frac{1}{2}$ when the other eye was shut, and nearly 2 when his hand was laid upon it.

151 When one eye is closed, the pupil of the other is enlarged.

Upon examining this phenomenon, it presently appeared to depend upon the enlargement of the pupil of one eye when the other is closed, the physical cause of which he did not pretend to assign; but he observes, that it is wisely appointed by Providence, in order that when one eye fails, the field of view in the other may be extended. That this effect should be more sensible when the eye is covered with the hand, is owing, he observes, to the eyelids not being impervious to the light. But the augmentation of the pupil does not enlarge the field of view, except in looking through a hole, as in this particular case; and therefore persons who are blind of one eye can derive no advantage from this circumstance.

A great deal has been written by Gassendi, Le Clere, Musschenbroek, and Du Tour, concerning the place to which we refer an object viewed by one or both eyes. But the most satisfactory account of this matter that we have met with, will be found in Dr Wells's Essay above quoted.

Sect. VI. *Of the Appearance of Objects seen through Media of different Forms.*

152 The various appearances of objects seen thro' media of different forms stated and investigated.

For the more easy apprehension of what relates to this subject, we shall premise the five following particulars, which either have been already mentioned, or follow from what has been before laid down.

1. That as each point of an object, when viewed by the naked eye, appears in its proper place, and as that place is always to be found in the line in which the axis of a pencil of rays flowing from it enters the eye, or else in the line which Dr Wells calls the common axis; we hence acquire a habit of considering the point to be situated in that line: and, because the mind is unacquainted with what refractions the rays suffer before they enter the eye, therefore, in cases where they are diverted from their natural course, by passing through any medium, it judges the point to be in that line produced back in which the axis of a pencil of rays flowing from it is situated the instant they enter the eye, and not in that it was in before refraction. We shall, therefore, in what follows, suppose the apparent place of an object, when seen through a refracting medium, to be somewhere in that line produced back in which the axis of a pencil of rays flowing from it proceeds after they have passed through the medium.

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2. That we are able to judge, though imperfectly, of the distance of an object by the degree of divergency, wherein the rays flowing from the same point of the object enter the pupil of the eye, in cases where that divergency is considerable; but because in what follows it will be necessary to suppose an object, when seen through a medium whereby its apparent distance is altered, to appear in some determinate situation, in those cases where the divergency of the rays at their entrance into the eye is considerable, we will suppose the object to appear where those lines which they describe in entering, if produced back, would cross each other: though it must not be asserted, that this is the precise distance; because the brightness, distinctness, and apparent magnitude of the object, on which its apparent distance in some measure depends, will also suffer an alteration by the refraction of the rays in passing through that medium.

3. That we estimate the magnitude of an object by that of the optic angle.

4. That vision is the brighter, the greater the number of rays is which enter the pupil.

5. And that, in some cases, the apparent brightness, distinctness, and magnitude of an object, are the only means by which our judgement is determined in estimating the distance of it.

Prop. I.

An object placed within a medium terminated by a plane surface on that side which is next the eye, if the medium be denser than that in which the eye is (as we shall suppose it to be, unless where the contrary is expressed), appears nearer to the surface of the medium than it is.

Thus, if A (fig. 5.) be a point of an object placed within the medium BCDE, and $A\,b\,A\,c$ be two rays proceeding from thence, these rays passing out of a denser into a rarer medium, will be refracted from their respective perpendiculars $b\,d$, $c\,e$, and will enter the eye at H, suppose in the directions $b\,f$, $c\,g$: let then these lines be produced back till they meet in F; this will be the apparent place of the point A; and because the refracted rays $b\,f$, $c\,g$ will diverge more than the incident ones $A\,b$, $A\,c$, it will be nearer to the points b and c than the point A; and as the same is true of each point in the object, the whole will appear to an eye at H, nearer to the surface BC than it is. Plate CCCLXXXI. Fig. 5.

Hence it is, that when one end of a straight stick is put under water, and the stick is held in an oblique position, it appears bent at the surface of the water; viz. because each point that is under water appears nearer the surface, and consequently higher than it is.

From this likewise it happens, that an object at the bottom of a vessel may be seen when the vessel is filled with water, though it be so placed with respect to the eye, that it cannot be seen when the vessel is empty. To explain this, let ABCD (fig. 6.) represent a vessel, and let E be an object lying at the bottom of it. This object, when the vessel is empty, will not be seen by an eye Fig. 6.

Appearance of Objects thro' Media of different Forms.

eye at F, because HE, the upper part of the vessel, will obstruct the ray EH; but when it is filled with water to the height GH, the ray at EK being refracted at the surface of the water into the line KF, the eye at F shall see the object by means of that.

153
An object situated in the horizon appears above its true place.

In like manner, an object situated in the horizon appears above its true place, on account of the refraction of the rays which proceed from it in their passage through the atmosphere. For, first, If the object be situated beyond the limits of the atmosphere, its rays in entering it will be refracted towards the perpendicular; that is, towards a line drawn from the point where they enter, to the centre of the earth, which is the centre of the atmosphere: and as they pass on, they will be continually refracted the same way, because they are all along entering a denser part, the centre of whose convexity is still the same point; upon which account the line they describe will be a curve bending downwards: and therefore none of the rays that come from that object can enter an eye upon the surface of the earth, except what enter the atmosphere higher than they need to do if they could come in a right line from the object: consequently the object must appear above its proper place. Secondly, If the object be placed within the atmosphere, the case is still the same; for the rays which flow from it must continually enter a denser medium whose centre is below the eye; and therefore being refracted towards the centre, that is, downwards as before, those which enter the eye must necessarily proceed as from some point above the object; whence the object will appear above its proper place.

Hence it is, that the sun, moon, and stars, appear above the horizon, when they are just below it; and higher than they ought to do, when they are above it: Likewise distant hills, trees, &c. seem to be higher than they are.

Besides, The lower these objects are in the horizon, the greater is the obliquity with which the rays which flow from them enter the atmosphere, or pass from the rarer into the denser parts of it; and therefore they appear to be the more elevated by refraction: on which account the lower parts of them are apparently more elevated than the rest. This makes their upper and under parts seem nearer than they are; as is evident from the sun and moon, which appear of an oval form when they are in the horizon, their horizontal diameters appearing of the same length that they would do if the rays suffered no refraction, while their vertical ones are thus shortened.

Prop. II.

An object seen through a medium terminated by plane and parallel surfaces, appears nearer, brighter, and larger, than with the naked eye.

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An object seen thro' a plane medium appears nearer and brighter than seen by the naked eye.
Plate CCCLXXXI. Fig. 7.

For instance, let AB (fig. 7.) be the object, CDEF the medium, and GH the pupil of an eye, which is here drawn large to prevent confusion in the figure.—And, 1. Let RK, RL, be two rays proceeding from the point R, and entering the denser medium at K and L; these rays will here by refraction be made to diverge less, and to proceed afterwards, suppose in the lines K*a*, L*b*; at *a* and *b*, where they pass out of the denser medium, they will be as much refracted the contrary way, proceeding in the lines *ac*, *bd*, parallel to their first directions. Produce these lines back till they meet in *e*: this will be the apparent place of the point R; and it is evident from the figure, that it must be nearer the eye than that point; and because the same is true of all other pencils flowing from the object AB, the whole will be seen in the situation *fg*, nearer to the eye than the line AB. 2. As the rays RK, RL would not have entered the eye, but have passed by it in the directions K*r*, L*t*, had they not been refracted in passing through the medium, the object appears brighter. 3. The rays A*h*, B*i*, will be refracted at *h* and *i* into the less converging lines *hk*, *il*, and at the other surface into *k*M, *l*M, parallel to A*h* and B*i* produced; so that the extremities of the object will appear in the lines M*k*, M*l* produced, viz. in *f* and *g*, and under as large an angle *f*M*g*, as the angle A*q*B under which an eye at *q* would have seen it had there been no medium interposed to refract the rays: and therefore it appears larger to the eye at GH, being seen through the interposed medium, than otherwise it would have done. But it is here to be observed, that the nearer the point *e* appears to the eye on account of the refraction of the rays RK, RL, the shorter is the image *fg*, because it is terminated by the lines M*f* and M*g*, upon which account the object is made to appear less; and therefore the apparent magnitude of an object is not much augmented by being seen through a medium of this form.

Farther, it is apparent from the figure, that the effect of a medium of this form depends wholly upon its thickness; for the distance between the lines R*r* and *ec*, and consequently the distance between the points *e* and R, depends upon the length of the line K*a*:—Again, The distance between the lines AM and *f*M depends on the length of the line *hk*; but both K*a* and *kh* depend on the distance between the surfaces CE and DF, and therefore the effect of this medium depends upon its thickness.

Prop. III.

An object seen through a convex lens, appears larger, brighter, and more distant, than with the naked eye.

To illustrate this, let AB (fig. 8.) be the object, CD the lens, and EF the eye. 1. From A and B, the extremities of the object, draw the lines AY*r*, BX*r*, crossing each other in the pupil of the eye; the angle A*r*B comprehended between these lines, is the angle under which the object would be seen with the naked eye. But by the interposition of a lens of this form, whose property it is to render converging rays more so, the rays AY and BX will be made to cross each other before they reach the pupil. There the eye at E will not perceive the extremities of the object by means of these rays (for they will pass it without entering), but by some others which must fall without the points Y and X, or between them; but if they fall between them, they will be made to concur sooner than they themselves would have done: and therefore, if the extremities of the object could not be seen by them, it will much less be seen by these. It remains therefore, that the rays which will enter the eye from the points A and B after refraction, must fall upon the lens without the points Y and X;

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Seen thro' a convex lens, appears larger, brighter, and more distant.
Fig. 8.

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X; let then the rays AO and BP be ſuch. Theſe after refraction entering the eye at *r*, the extremities of the object will be ſeen in the lines *r* Q, *r* T, produced, and under the optic angle Q *r* T, which is larger than A *r* B, and therefore the apparent magnitude of the object will be increaſed.—2. Let GHI be a pencil of rays flowing from the point G; as it is the property of this lens to render diverging rays leſs diverging, parallel, or converging, it is evident that ſome of thoſe rays, which would proceed on to F and E, and miſs the eye were they to ſuffer no refraction in paſſing through the lens, will now enter it; by which means the object will appear brighter. 3. The apparent diſtance of the object will vary according to the ſituation of it with reſpect to the focus of parallel rays of the lens. 1. Then, let us ſuppoſe the object placed ſo much nearer the lens than its focus of parallel rays, that the refracted rays KE and LF, though rendered leſs diverging by paſſing through it, may yet have a conſiderable degree of divergency, ſo that we may be able to form a judgement of the diſtance of the object thereby. In this caſe, the object ought to appear where EK, FL, produced back concur; which, becauſe they diverge leſs than the rays GH, GI, will be beyond G, that is, at a greater diſtance from the lens than the object is. But becauſe both the brightneſs and magnitude of the object will at the ſame time be augmented, prejudice will not permit us to reckon it quite ſo far off as the point where thoſe lines meet, but ſomewhere between that point and its proper place. 2. Let the object be placed in the focus of parallel rays, then will the rays KE and LF become parallel; and though in this caſe the object would appear at an immenſe diſtance, if that diſtance were to be judged of by the direction of the rays KE and LF, yet on account of its brightneſs and magnitude, we ſhall not think it much farther from us than if it were ſeen by the naked eye. 3. If the object be ſituated beyond the focus of parallel rays, as in BA, the rays flowing from it, and falling upon the lens CD, will be collected into their reſpective foci at *a* and *b*, and the intermediate points *m*, *n*, &c. and will there form an image of the object AB; and after croſſing each other in the ſeveral points of it, as expreſſed in the figure, will paſs on diverging as from a real object. Now if an eye be ſituated at *c*, where A *c*, B *c*, rays proceeding from the extreme points of the object, make not a much larger angle A *c* B, than they would do if no lens were interpoſed, and the rays belonging to the ſame pencil do not converge ſo much as thoſe which the eye would receive if it were placed nearer to *a* or *b*, the object upon theſe accounts appearing very little larger or brighter than with the naked eye, is ſeen nearly in its proper place: but if the eye recede a little way towards *a b*, the object then appearing both brighter and larger, ſeems to approach the lens: which is an evident proof of what has been ſo often aſſerted, viz. that we judge of the diſtance of an object in ſome meaſure by its brightneſs and magnitude; for the rays converge the more the farther the eye recedes from the lens; and therefore if we judged of the diſtance of the object by the direction of the rays which flow from it, we ought in this caſe to conceive it at a greater diſtance, than when the rays were parallel, or diverged at their entrance into the eye.

Plate CCLXXXI fig. 9.

That the object ſhould ſeem to approach the lens in this caſe, was a difficulty that puzzled Dr Barrow, and which he pronounces inſuperable, and not to be accounted for by any theory we have of viſion. Molineux alſo leaves it to the ſolution of others, as that which will be inexplicable, till a more intimate knowledge of the viſive faculty, as he expreſſes it, he obtained by mortals.

They imagined, that ſince an object appears farther off, the leſs the rays diverge which fall upon the eye, if they ſhould proceed parallel to each other, it ought to appear exceeding remote; and if they ſhould converge, it ſhould then appear more diſtant ſtill: the reaſon of this was, becauſe they looked upon the apparent place of an object, as owing only to the direction of the rays whatever it was, and not at all to its apparent magnitude or ſplendour.

Perhaps it may proceed from our judging of the diſtance of an object in ſome meaſure by its magnitude, that the deception of ſight commonly obſerved by travellers may ariſe; viz. that upon the firſt appearance of a building larger than uſual, as a cathedral church, or the like, it generally ſeems nearer to them, than they afterwards find it to be.

Prop. IV.

If an object be placed farther from a convex lens than its focus of parallel rays, and the eye be ſituated farther from it on the other ſide than the place where the rays of the ſeveral pencils are collected into their proper foci, the object appears inverted, and pendulous in the air, between the eye and the lens.

156 In certain circumſtances an object ſeen through a convex lens appears inverted and pendulous in the air. Fig. 9.

To explain this, let AB repreſent the object, CD the lens; and let the rays of the pencil ACD be collected in *a*, and thoſe of BCD in *b*, forming there an inverted image of the object AB, and let the eye be placed in F: it is apparent from the figure, that ſome of the refracted rays which paſs through each point of the image will enter the eye as from a real object in that place; and therefore the object AB will appear there, as the propoſition aſſerts. But we are ſo little accuſtomed to ſee objects in this manner, that it is very difficult to perceive the image with one eye; but if both eyes are ſituated in ſuch a manner, that rays flowing from each point of the image may enter both, as at G and H, and we direct our optic axes to the image, it is eaſy to be perceived.

If the eye be ſituated in *a* or *b*, or very near them on either ſide, the object appears exceedingly indiſtinct, viz. if at *d*, the rays which proceed from the ſame point of the object converge ſo very much, and if at *e*, they diverge ſo much, that they cannot be collected together upon the retina, but fall upon it as if they were the axes of ſo many diſtinct pencils coming through every point of the lens; wherefore little more than one ſingle point of the object is ſeen at a time, and that appears all over the lens; whence nothing but indiſtinctneſs ariſes.

If the lens be ſo large that both eyes may be applied to it, as in *h* and *k*, the object will appear double; for it is evident from the figure, that the rays which enter the eye at *h* from either extremity of the object A or B, do not proceed as from the ſame point with that

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that from whence those which enter the other at k seem to flow; the mind therefore is here deceived, and looks upon the object as situated in two different places, and therefore judges it to be double.

PROP. V.

157 An object through a concave lens is seen nearer, smaller, and less bright than with the naked eye.

An object seen through a concave lens appears nearer, smaller, and less bright, than with the naked eye.

Fig. 10.

Thus, let AB (fig. 10.) be the object, CD the pupil of an eye, and EF the lens. Now, as it is the property of a lens of this form to render diverging rays more so, and converging ones less so, the diverging rays GH, GI, proceeding from the point G, will be made to diverge more, and so to enter the eye as from some nearer point g; and the rays AH, BI, which converge, will be made to converge less, and to enter the eye as from the points a and b; wherefore the objects will appear in the situation $a\,g\,h$, less and nearer than without the lens. Further, As the rays which proceed from G are rendered more diverging, some of them will pass by the pupil of the eye, which otherwise would have entered it, and therefore each point of the object will appear less bright.

PROP. VI.

An object seen through a polygonal glass, that is, one which is terminated by several plain surfaces, is multiplied thereby.

Plate CCCLXXXI. Fig. 11.

Let A be an object, and BC a polygonous glass terminated by the plane surfaces BD, DE, &c. and let the situation of the eye F be such, that the rays AB being refracted in passing through the glass, may enter it in the direction BF, and the rays AC in the direction CF. Then will the eye, by means of the former, see the object in G, and by the latter in H; and by means of the rays AI, the object will also appear in its proper situation A.

SECT. VII. *On the Reflection of Light.*

158 Some portion of light always reflected from transparent bodies.

WHEN a ray of light falls upon any body, however transparent, the whole of it never passes through the body, but some part is always reflected from it; and it is by this reflected light that all bodies which have no light of their own become visible to us. Of that part of the ray which enters, another part is also reflected from the second surface, or that which is farthest from the luminous body. When this part arrives again at the first surface, part of it is reflected back from that surface; and thus it continues to be reflected between the two surfaces, and to pass backwards and forwards within the substance of the medium, till some part is totally extinguished and lost. Besides this inconsiderable quantity, however, which is lost in this manner, the second surface often reflects much more than the first; so that, in certain positions, scarcely any rays will pass through both sides of the medium. A very considerable quantity is also unaccountably lost at each reflecting surface; so that no body, however transparent, can transmit all the rays which fall upon it; neither, though it be ever so well fitted for reflection, will it reflect them all.

On the Cause of Reflection.

Cause of Reflection.

The reflection of light is not so easily accounted for as refraction. This last property may be accounted for in a satisfactory manner, by the supposition of an attractive power diffused throughout the medium, and extending a very little way beyond it; but with regard to the reflection of light, there seems to be no satisfactory hypothesis hitherto invented. Of the principal opinions on this subject Mr Rowning has given us the following account.

I. It was the opinion of philosophers, before Sir Isaac Newton discovered the contrary, that light is reflected by impinging upon the solid parts of bodies. But that this is not the case is evident from the following reasons. 159 Light is not reflected by impinging on the solid parts of bodies at the first surface,

First, It is not reflected at the first surface of a body by impinging against it. For in order that the light may be regularly reflected, there should be no asperities or unevenness in the reflecting surface large enough to bear a sensible proportion to the magnitude of a ray of light; because if the surface abound with these, the incident rays would be irregularly scattered rather than reflected with that regularity with which light is observed to be from a well polished surface. Now those surfaces, which to our senses appear perfectly smooth and well polished, are far from being so; for to polish, is only to grind off the larger protuberances of the metal with the rough and sharp particles of emery, which must of necessity leave behind them an infinity of asperities and scratches, which, though inconsiderable with regard to the former roughnesses, and too minute to be discerned by us, must nevertheless bear a large proportion to, if not vastly exceed, the magnitude of the particles of light.

Secondly, It is not reflected at the second surface by impinging against any solid particles. That it is not reflected by impinging upon the solid particles which constitute this second surface, is sufficiently obvious from the foregoing argument; the second surfaces of bodies being as incapable of a perfect polish as the first: and it is farther confirmed from this, viz. that the quantity of light reflected differs according to the different density of the medium behind the body. It is likewise not reflected by impinging upon the particles which constitute the surface of the medium behind it, because the strongest reflection at the second surface of a body, is when there is a vacuum behind it. 160 nor at the second.

II. It has been the opinion of some, that light is reflected at the first surface of a body, by a repulsive force equally diffused over it: and at the second, by an attractive force. 161 Supposition of a repulsive force;

1. If there be a repulsive force diffused over the surface of bodies that repels the rays of light, then, since by increasing the obliquity of a ray we diminish its perpendicular force (which is that only whereby it must make its way through this repulsive force), however weakly that force may be supposed to act, rays of light may be made to fall with so great a degree of obliquity on the reflecting surface, that there shall be a total reflection of them there, and not one particle of light be able to make its way through: which is contrary to observation; the reflection of light at the first surface of a transparent body being never total in any obliquity whatever. 162 objected to.

2. As to the reflection at the second surface by the attractive 163 Attractive force supposed;

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attractive force of the body; this may be considered in two respects: first, when the reflection is total; secondly, when it is partial.

First, In cases where the reflection is total, the cause of it is undoubtedly that same attractive force by which light would be refracted in passing out of the same body. This is manifest from that analogy which is observable between the reflection of light at the second surface, and its refraction there. For, otherwise, what can be the reason that the total reflection should begin just when the obliquity of the incident ray, at its arrival at the second surface, is such, that the refracted angle ought to be a right one; or when the ray, were it not to return in reflection, ought to pass on parallel to the surface, without going from it? For in this case it is evident, that it ought to be returned by this very power, and in such a manner that the angle of reflection shall be equal to the angle of incidence; just as a stone thrown obliquely from the earth, after it is so far turned out of its course by the attraction of the earth, as to begin to move horizontally, or parallel to the surface of the earth, is then by the same power made to return in a curve similar to that which is described in its departure from the earth, and so falls with the same degree of obliquity that it was thrown with.

164 Objection.

But, secondly, As to the reflection at the second surface, when it is partial; an attractive force uniformly spread over it, as the abettors of this hypothesis conceive it to be, can never be the cause thereof. Because it is inconceivable, that the same force, acting in the same circumstances in every respect, can sometimes reflect the violet-coloured rays, and transmit the red, and at other times reflect the red and transmit the violet.

This objection, however, is not well founded; for in each colour, the reflection takes place at that angle, and no other, where the refraction of *that* ray would make it parallel to the posterior surface.

This partial reflection and refraction is a great difficulty in all the attempts which have been made to give a mechanical explanation of the phenomena of optics. It is equally a desideratum in that explanation which was proposed by Huygens, by means of the undulations of an elastic fluid, although a vague consideration of undulatory motions seems to offer a very specious analogy. But a *rigid* application of the *knowledge* we have acquired of these motions, will convince us that the phenomena of undulation are essentially dissimilar to the phenomena of light. The inflection and refraction of light, demonstrate that light *is acted on* by moving forces in a direction perpendicular to the surface; and it is equally demonstrable that such forces must, in proper circumstances, produce reflections precisely such as we observe. The only difficulty is to show how there can be forces which produce both reflection and refraction, in circumstances which are similar. The fact is, that such effects are produced: the first logical inference is, that with respect to the light which is reflected and that which is refracted, the circumstances are *not* similar; and our attention should be directed to the discovery of that dissimilarity. All the phenomena of combined reflection and refraction should be examined and classed according to their generality, not doubting but that these points of resemblance will lead to the discovery of their causes. Now the experiments of M. Bouguer show that bodies differ in their powers of thus separating light by reflection and refraction. It is not therefore *a general property of light* to be partly reflected and partly refracted, but a *distinctive* property of *different* bodies; and since we see that they possess it in different degrees, we are authorized to conclude that some bodies may want it altogether. We may therefore expect some success, by considering how bodies are affected by light, as well as how light is affected by bodies. Now, in all the phenomena of the material world we find bodies connected by mutual forces. We know no case where a body A tends towards a body B, or, in common language, is attracted by it, without, at the same time, the body B tending towards A. This is observed in the phenomena of magnetism, electricity, gravitation, corpuscular attraction, impulse, &c. We should therefore conclude from analogy, that as bodies change the motion of light, light also changes the motion of bodies; and that the particles near the surface are put into vibration by the passage of light through among them. 165

165 The objection obviated.

Suppose a parcel of cork balls all hanging as pendulums in a symmetrical order, and that an electrified ball passes through the midst of them; it is very easy to show that it may proceed through this assemblage in various directions with a sinuated motion, and without touching any of them, and that its ultimate direction will have a certain inclination to its primary direction, depending on the outline of the assemblage, just as is observed in the motion of light; and, in the mean time, the cork balls will be variously agitated. Just so must it happen to the particles of a transparent body, if we suppose that they act on the particles of light by mutual attractions and repulsions.

An attentive consideration of what happens here will show us that the superficial particles will be much more agitated than the rest; and thus a stratum be produced, which, in any instant, will act on those particles of light which are then approaching them in a manner different from that in which they will act on similarly situated particles of light, which come into the place of the first in the following moment, when these acting particles of the body have (by their motion of vibration) changed their own situation. Now it is clearly understood, that, in all motions of vibration, such as the motions of pendulums, there is a moment when the body is in its natural situation, as when the pendulum is in the vertical line. This may happen in the same instant in each atom of the transparent body. The particles of light which then come within the sphere of action may be wholly reflected; in the next moment, particles of light in the very situation of the first may be refracted.

Then will arise a separation of light; and as this will depend on the manner in which the particles of bodies are agitated by it during its passage, and as this again will depend on the nature of the body, that is, on the law of action of those forces which connect the particles with each other, and with the particles of light, it will be different in different bodies. But in all bodies there will be this general resemblance, that the separation will be most copious in great obliquities of incidence, which gives the repulsive forces more time for action, while it diminishes the perpendicular force of the light. Such a resemblance between the phenomena and the

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the legitimate consequences of the assumption (the agitation of the parts of the body), gives us some authority for assigning this as the cause; nor can the assumption be called *gratuitous*. To suppose that the particles of the transparent body *are not thus agitated*, would be a most gratuitous contradiction of a law of nature to which we know no other exception.

Thus the objection stated in N° 164. is obviated, because the reflection and refraction are not here conceived as simultaneous, but as successive.

166 Another hypothesis. III. Some have supposed, that, by the action of light upon the surface of bodies, their parts are put into an undulatory motion; and that where the surface of it is subsiding light is transmitted, and in those places where it is rising light is reflected.

But to overlook the objections which we have just made to this theory of undulation, we have only to observe, that, were it admitted, it does not seem to advance us a step farther; for in those cases, suppose where red is reflected and violet transmitted, how comes it to pass that the red impinges only on those parts when the waves are rising, and the violet when they are subsiding?

167 Sir I. Newton's hypothesis; IV. The next hypothesis is that remarkable one of Sir Isaac Newton's fits of easy reflection and transmission, which we shall now explain and examine.

That author, as far as we can apprehend his meaning in this particular, is of opinion, that light in its passage from the luminous body, is disposed to be alternately reflected by, and transmitted through, any refracting surface it may meet with; that these dispositions, which he calls *fits of easy reflection and easy transmission*, return successively at equal intervals; and that they are communicated to it at its first emission out of the luminous body, from which it proceeds probably by some very subtile and elastic substance diffused through the universe, and that in the following manner. As bodies falling into water, or passing through the air, produce undulations in each, so the rays of light may excite vibrations in this elastic substance. The quickness of these vibrations depending on the elasticity of the medium (as the quickness of the vibrations in the air, which propagate sound, depend solely on the elasticity of the air, and not upon the quickness of those in the sounding body), the motion of the particles of it may be quicker than that of the rays, and therefore, when a ray at the instant it impinges upon any surface, is in that part of a vibration of this elastic substance which conspires with its motion, it may be easily transmitted; and when it is in that part of a vibration which is contrary to its motion, it may be reflected. He further supposes, that when light falls upon the surface of a body, if it be not in a fit of easy transmission, every ray is there put into one, so that when they come at the other side (for this elastic substance, pervading the pores of bodies, is capable of the same vibrations within the body as without it), the rays of one colour shall be in a fit of easy transmission, and those of another in a fit of easy reflection, according to the thickness of the body, the intervals of the fits being different in rays of a different kind. This seems to account for the different colours of the bubble and thin plate of air and water; and likewise for the reflection of light at the second surface of a thicker body; for the light thence reflected is also observed to be coloured, and to form rings according to the different thickness of the body, when not intermixed and confounded with other light, as will appear from the following experiment. If a piece of glass be ground concave on one side and convex on the other, both its concavity and convexity having one common centre; and if a ray of light be made to pass through a small hole in a piece of paper held in that common centre, and be permitted to fall on the glass; besides those rays which are regularly reflected back to the hole again, there will be others reflected to the paper, and form coloured rings surrounding the hole, not unlike those occasioned by the reflection of light from thin plates.

It is ever with extreme reluctance that we venture to call in question the doctrines of Newton; but to his theory of reflection there is this insuperable objection, that it explains nothing, unless the *cause* of the fits of more easy reflection and transmission be held as legitimate, namely, that *they are produced by the undulations of another elastic fluid, incomparably more subtile than light*, acting upon it in the way of impulse. The fits themselves are *matters of fact*, and no way different from what we have endeavoured to account for; but to admit this theory of them would be to transgress every rule of philosophizing. 168 This hypothesis untenable.

Of the Laws of Reflection.

The fundamental law of the reflection of light, is, that the angle of reflection is always equal to the angle of incidence. This is found by experiment to be the case, and besides may be demonstrated mathematically from the laws of impulse in bodies perfectly elastic. The axiom therefore holds good in every case of reflection, whether it be from plane or spherical surfaces; and hence the seven following propositions relating to the reflection of light from plane and spherical surfaces may be deduced. 169 The fundamental law of reflection.

I. *Rays of light reflected from a plane surface have the same degree of inclination to one another that their respective incident ones have.*—For the angle of reflection of each ray being equal to that of its respective incident one, it is evident, that each reflected ray will have the same degree of inclination to that portion of the surface from which it is reflected that its incident one has; but it is here supposed, that all those portions of surface from which the rays are reflected, are situated in the same plane; consequently the reflected rays will have the same degree of inclination to each other that their incident ones have, from whatever part of the surface they are reflected.

II. *Parallel rays reflected from a concave surface are rendered converging.*—To illustrate this, let AF, CD, EB, (fig. 1.) represent three parallel rays falling upon the concave surface FB, whose centre is C. To the points F and B draw the lines CF, CB; these being drawn from the centre, will be perpendicular to the surface at those points. The incident ray CD also passing through the centre, will be perpendicular to the surface, and therefore will return after reflection in the same line; but the oblique rays AF and EB will be reflected into the lines FM and BM, situated on the contrary side of their respective perpendiculars CF and CB. They will therefore proceed converging after reflection towards some point, as M, in the line CD. 170 Laws of reflection from a concave surface. Plate CCCLXXXII. fig. 1.

III. *Converging rays falling on a concave surface, are made*

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made to converge more.—For, every thing remaining as above, let GF, HB, be the incident rays. Now, becaufe thefe rays have greater angles of incidence than the parallel ones AF and EB in the foregoing cafe, their angles of reflection will alfo be larger than thofe of the others; they will therefore converge after reflection, fuppofe in the lines FN and BN, having their point of concourfe N farther from the point C than M, that to which the parallel rays AF and EB converged to in the foregoing cafe; and their precife degree of convergency will be greater than that wherein they converged before reflection.

IV. *Diverging rays falling upon a concave furface, are, after reflection, parallel, diverging, or converging.* If they diverge from the focus of parallel rays, they then become parallel; if from a point nearer to the furface than that, they will diverge, but in a lefs degree than before reflection; if from a point between that and the centre, they will converge after reflection, to fome point on the contrary fide of the centre, but fituated farther from it than the radiant point. If the incident rays diverge from a point beyond the centre, the reflected ones will converge to one on the other fide of it, but nearer to it than the radiant point; and if they diverge from the centre, they will be reflected thither again.

1. Let them diverge in the lines MF, MB, proceeding from the radiant point M, the focus of parallel rays; then, as the parallel rays AF and EB were reflected into the lines FM and BM (by Prop. ii.), thefe rays will now on the contrary be reflected into them.

2. Let them diverge from N, a point nearer to the furface than the focus of parallel rays, they will then be reflected into the diverging lines FG and BH, which the incident rays GF and HB defcribed that were fhown to be reflected into them in the foregoing propofition; but the degree of their divergency will be lefs than their divergency before reflection.

3. Let them diverge from X, a point between the focus of parallel rays and the centre; they then make lefs angles of incidence than the rays MF and MB, which became parallel by reflection: they will confequently have lefs angles of reflection, and therefore proceed converging towards fome point, as Y; which point will always fall on the contrary fide of the centre, becaufe a reflected ray always falls on the contrary fide of the perpendicular with refpect to that on which its incident one falls; and of confequence it will be farther diftant from the centre than X.

4. If the incident rays diverge from Y, they will, after reflection, converge to X; thofe which were the incident rays in the former cafe being the reflected ones in this.

5. If the incident rays proceed from the centre, they fall in with their refpective perpendiculars; and for that reafon are reflected thither again.

171 From a convex furface. Plate CCLXXXII. fig. 2.

V. *Parallel rays reflected from convex furfaces are rendered diverging.*—For, let AB, GD, EF, be three parallel rays falling upon the convex furface BF, whofe centre is C, and let one of them, viz. GD, be perpendicular to the furface. Through B, D, and F, the points of reflection, draw the lines CV, CG, and CT; which, will be perpendicular to the furface at thefe points. The incident ray GD being perpendicular to the furface, will return after reflection in the fame line, but the oblique ones AB and EF will return in the lines BK and FL, fituated on the contrary fide of their refpective perpendiculars BV and FT. They will therefore diverge, after reflection, as from fome point M in the line GD produced; and this point will be in the middle between D and C.

VI. *Diverging rays reflected from convex furfaces are rendered more diverging.*—For, things remaining as above, let GB, GF, be the incident rays. Thefe having greater angles of incidence than the parallel ones AB and EF in the preceding cafe, their angles of reflection will alfo be greater; they will therefore diverge after reflection, fuppofe in the lines BP and FQ, as from fome point N, farther from C than the point M; and the degree of their divergency will exceed their divergency before reflection.

VII. *Converging rays reflected from convex furfaces are parallel, converging, or diverging.*—If they tend towards the focus of parallel rays, they then become parallel; if to a point nearer the furface, they converge, but in a lefs degree than before reflection; if to a point between that and the centre, they will diverge after reflection, as from fome point on the contrary fide of the centre, but fituated farther from it than the point to which they converged; if the incident rays converge to a point beyond the centre, the reflected ones will diverge as from one on the contrary fide of it, but nearer to it than the point to which the incident ones converged; and if the incident rays converge towards the centre, the reflected ones will feem to proceed from it.

1. Let them converge in the lines KB and LF, tending towards M, the focus of parallel rays; then, as the parallel rays AB, EF were reflected into the lines BK and FL (by Prop. v.), thofe rays will now on the contrary be reflected into them.

2. Let them converge in the lines PB, QF, tending towards N a point nearer the furface than the focus of parallel rays, they will then be reflected into the converging lines BG and FG, in which the rays GB, GF proceeded that were fhown to be reflected into them by the laft propofition: but the degree of their convergency will exceed their convergency before reflection.

3. Let them converge in the lines RB and SF proceeding towards X, a point between the focus of parallel rays and the centre; their angles of incidence will then be lefs than thofe of the rays KB and LF, which became parallel after reflection: their angles of reflection will therefore be lefs; on which account they muft neceffarily diverge, fuppofe in the lines BH and FI, from fome point, as Y; which point (by Prop. iv.) will fall on the contrary fide of the centre with refpect to X, and will be farther from it than that.

4. If the incident rays tend towards Y, the reflected ones will diverge as from X; thofe which were the incident ones in one cafe being the reflected ones in the other.

5. If the incident rays converge towards the centre, they coincide with their refpective perpendiculars; and will therefore proceed after reflection as from that centre.

We have already obferved, that in fome cafes there is a very great reflection from the fecond furface of a tranfparent body. The degree of inclination neceffary to caufe a total reflection of a ray at this furface, is that which requires that the refracted angle (fuppofing the ray to pafs out there) fhould be equal to or greater than a

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a right one; and consequently it depends on the refractive power of the medium through which the ray passes, and is therefore different in different media. When a ray passes through glass surrounded with air, and is inclined to its second surface under an angle of 42° or more, it will be wholly reflected there. For, as 11 is to 17 (the ratio of refraction out of glass into air), so is the sine of an angle of 42° to a fourth number that will exceed the sine of a right angle. Hence it follows, that when a ray of light arrives at the second surface of a transparent substance with as great or a greater degree of obliquity than that which is necessary to make a total reflection, it will there be all returned back to the first: and if it proceeds towards that with as great an obliquity as it did towards the other (which it will do if the surfaces of the medium be parallel to each other), it will there be all reflected again, &c. and will therefore never get out, but pass from side to side, till it be wholly extinguished within the body.—From this may arise an obvious inquiry, how it comes to pass, that light falling very obliquely upon a glass window from without, should be transmitted into the room. In answer to this it must be considered, that however obliquely a ray falls upon the surface of any medium whose sides are parallel as those of the glass in a window, it will suffer such a degree of refraction in entering there, that it shall fall upon the second with a less obliquity than that which is necessary to cause a total reflection. For since the medium be glass: then, as 17 is to 11, so is the sine of the greatest angle of incidence with which a ray can fall upon any surface to the sine of a less angle than that of total reflection. Therefore, if the sides of the glass be parallel, the obliquity with which a ray falls upon the first surface cannot be so great, that it shall pass the second without suffering a total reflection there.

When light passes out of a denser into a rarer medium, the nearer the second medium approaches the first in its refractive power, the less of it will be refracted in passing from one to the other; and when their refracting powers are equal, all of it will pass into the second medium.

The above propositions may be all mathematically demonstrated in the following manner:

Prop. I.

Of the reflection of rays from a plane surface.

172 The preceding propositions demonstrated mathematically.

When rays fall upon a plane surface, if they diverge, the focus of the reflected rays will be at the same distance behind the surface, that the radiant point is before it: if they converge, it will be at the same distance before the surface that the imaginary focus of the incident rays is behind it.

This proposition admits of two cases.

Case 1. *Of diverging rays.*

Plate CCCLXXXII Fig. 3.

Let AB, AC be two diverging rays incident on the plane surface DE, the one perpendicularly, the other obliquely: the perpendicular one AB will be reflected to A, proceeding as from some point in the line AB produced; the oblique one AC will be reflected into some line as CF, so that the point G, where the line FG produced intersects the line AB produced also, shall be at an equal distance from the surface DE with the radiant point A. For the perpendicular CH being drawn, ACH and HCF will be the angles of incidence and reflection; which being equal, their complements ACB and FCE are also equal: but the angle BCG is equal to its vertical angle FCE: therefore in the triangles ABC and GBC the angles at C are equal, the side BC is common, and the right angles at B are equal; therefore AB=BG: and consequently the point G, the focus of the incident rays AB, AC, is at the same distance behind the surface, that the point A is before it.

Case 2. *Of converging rays.*

This is the converse of the former case. For supposing FC and AB to be two converging incident rays, CA and BA will be the reflected ones (the angles of incidence in the former case being now the angles of reflection, and *vice versa*), having the point A for their focus; but this is at an equal distance from the reflecting surface with the point G, which in this case is the imaginary focus of the incident rays FC and AB.

It is not here, as in the case of rays passing through a plane surface, where some of the refracted rays proceed as from one point, and some as from another: but they all proceed after reflection as from one and the same point, however obliquely they may fall upon the surface; for what is here demonstrated of the ray AC holds equally of any other, as AI, AK, &c.

The case of parallel rays incident on a plane surface is included in this proposition: for in that case we are to suppose the radiant point infinitely distant from the surface, and then by the proposition the focus of the reflected rays will be so too: that is, the rays will be parallel after reflection, as they were before it.

Prop. II.

Of the reflection of parallel rays from a spherical surface.

When parallel rays are incident upon a spherical surface, the focus of the reflected rays will be the middle point between the centre of convexity and the surface.

This proposition admits of two cases.

Case 1. *Of parallel rays falling upon a convex surface.*

Let AB, DH, represent two parallel rays incident on the convex surface BH, the one perpendicularly, the other obliquely; and let C be the centre of convexity. Fig. 4.
Suppose HE to be the reflected ray of the oblique one DH, proceeding as from F, a point in the line AB produced. Through the point H draw the line CI, which will be perpendicular to the surface at that point; and the angles DHI and IHE, being the angles of incidence and reflection, will be equal. But HCF=DHI, the lines AC and DH being parallel; and CHF=IHE; wherefore the triangle CFH is isosceles, and consequently CF=FH: but supposing BH to vanish, FH=FB; and therefore upon this supposition FC=FB; that is, the focus of the reflected rays is the middle point between the centre of convexity and the surface.

Case 2. *Of parallel rays falling upon a concave surface.*

Let AB, DH, be two parallel rays incident, the one perpendicularly, the other obliquely, on the concave surface BH, whose centre of concavity is C. Let BF and HF be the reflected rays meeting each other in F; this will be the middle point between B and C. For drawing through C the perpendicular CH, the angles DHC=FHC, being the angles of incidence and reflection; but HCF=DHC its alternate angle, and therefore the triangle CFH is isosceles. Wherefore CF=FH: but if we suppose BH to vanish, FB=FH, and therefore Fig. 5.

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therefore CF=FB; that is, the focal diſtance of the reflected rays is the middle point between the centre and the ſurface.

It is here obſervable, that the farther the line DH, either in fig. 4. or 5. is taken from AB, the nearer the point F falls to the ſurface. For the farther the point H recedes from B, the greater the triangle CFH will become; and conſequently, ſince it is always iſoſceles and the baſe CH, being the radius, is everywhere of the ſame length, the equal legs CF and FH will lengthen; but CF cannot grow longer unleſs the point F approach towards the ſurface. And the farther H is removed from B, the faſter F approaches to it.

This is the reaſon, that whenever parallel rays are conſidered as reflected from a ſpherical ſurface, the diſtance of the oblique ray from the perpendicular one is taken ſo ſmall with reſpect to the focal diſtance of that ſurface, that without any phyſical error it may be ſuppoſed to vaniſh.

173 Reflected rays from a ſpherical ſurface never proced from the ſame point. Fig. 6.

Hence it follows, that if a number of parallel rays, as AB, CD, EG, &c. fall upon a convex ſurface, and if BA, DK, the reflected rays of the incident ones AB, CD, proceed as from the point F, thoſe of the incident ones CD, EG, viz. DK, GL, will proceed as from N, thoſe of the incident ones EG, HI, as from O, &c. becauſe the farther the incident ones CD, EG, &c. are from AB, the nearer to the ſurface are the points F, *f*, *f*, in the line BF, from which they proceed after reflection; ſo that properly the foci of the reflected rays BA, DK, GL, &c. are not in the line AB produced, but in a curve line paſſing through the points F, N, O, &c.

The ſame is applicable to the caſe of parallel rays reflected from a concave ſurface, as expreſſed by the dotted lines on the other half of the figure, where PQ, RS, TV, are the incident rays; QF, S*f*, V*f*, the reflected ones, interſecting each other in the points X, Y, and F; ſo that the foci of thoſe rays are not in the line FB, but in a curve paſſing through thoſe points.

174 Rays proceeding from one point, and falling on a parabolic concave ſurface, are all reflected from one point.

Had the ſurface BH in fig. 4. or 5. been formed by the revolution of a parabola about its axis having its focus in the point F, all the rays reflected from the convex ſurface would have proceeded as from the point F, and thoſe reflected from the concave ſurface would have fallen upon it, however diſtant their incident ones AB, DH, might have been from each other. For in the parabola, all lines drawn parallel to the axis make angles with the tangents to the points where they cut the parabola (that is, with the ſurface of the parabola) equal to thoſe which are made with the ſame tangents by lines drawn from thence to the focus; therefore, if the incident rays deſcribe thoſe parallel lines, the reflected ones will neceſſarily deſcribe theſe other, and ſo will all proceed as from, or meet in, the ſame point.

Prop. III.

Of the reflection of diverging and converging rays from a ſpherical ſurface.

175 Proportional diſtance of the focus of rays reflected from a ſpherical ſurface.

When rays fall upon any ſpherical ſurface, if they diverge, the diſtance of the focus of the reflected rays from the ſurface is to the diſtance of the radiant point from the ſame (or, if they converge, to that of the imaginary focus of the incident rays), as the diſtance of the focus of the reflected rays from the centre is to the diſtance of the radiant point (or imaginary focus of the incident rays) from the ſame.

Laws of Reflection. Fig. 7.

This propoſition admits of ten caſes.

Case 1. *Of diverging rays falling upon a convex ſurface.*

Let RB, RD, repreſent two diverging rays flowing from the point R as from a radiant, and falling the one perpendicularly, the other obliquely, on the convex ſurface BD, whoſe centre is C. Let DE be the reflected ray of the incident one RD; produce ED to F, and through R draw the line RH parallel to FE till it meets CD produced in H. Then RHD=EDH the angle of reflection, and RHD=RDH the angle of incidence; wherefore the triangle DRH is iſoſceles, and DR=RH. Now the lines FD and RH being parallel, the triangles FDC and RHC are ſimilar, or the ſides are cut proportionably, and therefore FD : RH or RD=CF : CR; but BD vaniſhing, FD and RD differ not from FB and RB: wherefore FB : RB=CF : CR; that is, the diſtance of the focus from the ſurface is to the diſtance of the radiant point from the ſame, as the diſtance of the focus from the centre is to the diſtance of the radiant point from it.

Case 2. *Of converging rays falling upon a concave ſurface.*

Let KD and CB be the converging incident rays, having their imaginary focus in the point R, which was the radiant point in the foregoing caſe. Then as RD was in that caſe reflected into DE, KD will in this be reflected into DF; for, ſince the angles of incidence in both caſes are equal, the angles of reflection will be equal alſo; ſo that F will be the focus of the reflected rays: but it was there demonſtrated, that FB : RB=CF : CR; that is, the diſtance of the focus from the ſurface is to the diſtance (in this caſe) of the imaginary focus of the incident rays, as the diſtance of the focus from the centre is to the diſtance of the imaginary focus of the incident rays from the ſame.

Case 3. *Of converging rays falling upon a convex ſurface, and tending to a point between the focus of parallel rays and the centre.*

Let B repreſent a convex ſurface whoſe centre is C, and whoſe focus of parallel rays is P; and let AB, KD, be two converging rays incident upon it, and having their imaginary focus at R, a point between P and C. Now becauſe KD tends to a point between the focus of parallel rays and the centre, the reflected ray DE will diverge from ſome point on the other ſide the centre, ſuppoſe F; as explained above. Through D draw the perpendicular CD and produce it to H; then will KDH=HDE being the angles of incidence and reflection, and conſequently RDC=CDF too. Therefore the triangle RDF is biſected by the line DC: wherefore (3 El. 6.) FD and DR, or BD vaniſhing, FB : BR=FC : CR; that is, the diſtance of the focus of the reflected rays is to that of the imaginary focus of the incident ones, as the diſtance of the former from the centre is to the diſtance of the latter from the centre. Fig. 8.

Case 4. *Of diverging rays falling upon a concave ſurface, and proceeding from a point between the focus of parallel rays and the centre.*

Let RB, RD, be the diverging rays incident upon the concave ſurface BD, having their radiant point in Fig.

R,

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R, the imaginary focus of the incident rays in the preceding case. Then as KD was in that case reflected into DE, RD will now be reflected into DF. But we had FB : RB=CF : CR; that is, the distance of the focus is to that of the radiant as the distance of the former from the centre is to the distance of the latter from the centre.

The angles of incidence and reflection being equal, it is evident, that if, in any case, the reflected ray be made the incident one, the incident will become the reflected one; and therefore the four following cases may be considered respectively as the converse of the four preceding; for in each of them the incident rays are supposed to coincide with the reflected ones in the other. Or they may be thus demonstrated independently of them.

Case 5. *Of converging rays falling upon a convex surface, and tending to a point nearer the surface than the focus of parallel rays.*

Fig. 7. Let ED, RB be the converging rays incident upon the convex surface BD whose centre is C, and principal focus P; let the imaginary focus of the incident rays be at F, a point between P and B; and let DR be the reflected ray. From C and R draw the lines CH, RH, the one passing through D, the other parallel to FE. Then RHD=HDE the angle of incidence. But RHD=HDR, the angle of reflection: wherefore the triangle HDR is isosceles, and DR=RH. Now the lines FD and RH being parallel, the triangles FDC and RHC are similar; and therefore RH or RD : FD=CR : CF; but BD vanishing, RD and FD coincide with RB and FB, wherefore RB : FB=CR : CF; that is, the distance of the focus from the surface is to the distance of the imaginary focus of the incident rays, as the distance of the focus from the centre is to the distance of the imaginary focus of the incident rays from the centre.

Case 6. *Of diverging rays falling upon a concave surface, and proceeding from a point between the focus of parallel rays and the surface.*

Let FD and FB be two rays diverging from the point F, which was the imaginary focus of the incident rays in the preceding case. Then as ED was in that case reflected into DR, FD will be reflected into DK (for the reason mentioned in case 2.), so that the reflected ray will proceed as from the point R: but it was demonstrated in case 5. that RB : FB=CR : CF; that is, the distance of the focus from the surface is to that of the radiant from the surface, as the distance of the former from the centre is to that of the latter from the centre.

Case 7. *Of converging rays falling upon a convex surface, and tending towards a point beyond the centre.*

Fig. 8. Let AB, ED be the incident rays tending to F, a point beyond the centre C, and let DK be the reflected ray of the incident one ED. Then because the incident ray ED tends to a point beyond the centre, the reflected ray DK will proceed as from one on the contrary side, suppose R; see Prop. vii. Through D draw the perpendicular CD, and produce it to H. Then will EDH=HDK, being the angles of incidence and reflection; but CDF=CDR, being their verticals: consequently the angle FDR is bisected by the line CD: wherefore, RD : DF, or (3 Elem. 6.) BD vanishing, RB : BF=RC : CF; that is, the distance of the focus of the reflected rays is to that of the imaginary focus of the incident rays, as the distance of the former from the centre is to the distance of the latter from the centre.

Case 8. *Of diverging rays falling upon a concave surface, and proceeding from a point beyond the centre.*

Let FB, FD be the incident rays radiating from F, the imaginary focus of the incident rays in the case. Then as ED was in that case reflected into DK, FD will now be reflected into DR; so that R will be the focus of the reflected rays. But it was demonstrated in the case 7. that RB : FB=RC : CF; that is, the distance of the focus of the reflected rays from the surface is to the distance of the radiant from the surface, as the distance of the focus of the reflected rays from the centre is to the distance of the radiant from the centre.

The two remaining cases may be considered as the converse of those under Prop. ii. (p.), because the incident rays in these are the reflected ones in them; or they may be demonstrated in the same manner with the preceding, as follows.

Case 9. *Converging rays falling upon a convex surface, and tending to the focus of parallel rays, become parallel after reflection.*

Plate CCLXXXIX. Fig. 7. Let ED, RB represent two converging rays incident on the convex surface BD, and tending towards F, which we shall now suppose to be the focus of parallel rays; and let DR be the reflected ray, and C the centre of convexity of the reflecting surface. Through C draw CD, and produce it to H, drawing RH parallel to ED produced to F. Now it has been demonstrated (case 5. where the incident rays are supposed to tend to the point F), that RB : FB=RC : CF; but F in this case being supposed to be the focus of parallel rays, it is the middle point between C and B (by Prop. ii.) and therefore FB=FC, consequently RB=RC; which can only be upon the supposition that R is at an infinite distance from B; that is, that the reflected rays BR and DR be parallel.

Case 10. *Diverging rays falling upon a concave surface, and proceeding from the focus of parallel rays, become parallel after reflection.*

Fig. 8. Let RD, RB be two diverging rays incident upon the concave surface BD, as supposed in case 4. where it was demonstrated that FB : RB=CF : CR. But in the present case RB=CR, because R is supposed to be the focus of parallel rays; therefore FB=FC; which cannot be unless F be taken at an infinite distance from B; that is, unless the reflected rays BF and DF be parallel.

It may here be observed that in the case of diverging rays falling upon a convex surface, the farther the point D is taken from B, the nearer the point F, the focus of the reflected rays, approaches to B, while the radiant point R remains the same. For it is evident from the curvature of a circle, that the point D may be taken so far from B, that the reflected ray DE shall proceed as from F, G, H, or even from B, or from any point between B and R; and the farther it is taken from B, the faster the point from which it proceeds approaches towards R: as will appear if we draw several incident rays with their respective reflected ones, in such a manner that the angles of reflection may be equal to their respective angles of incidence, as is done in the figure. The like is applicable to any of the other cases of diverging and converging rays incident upon a spherical surface. This is the reason, that, when rays are considered as reflected from a spherical surface, Laws of Reflection. surface, the distance of the oblique rays from the perpendicular one is taken so small, that it may be supposed to vanish.

From this it follows, that if a number of diverging rays are incident upon the convex surface BD at the several points B, D, D, &c. they will not proceed after reflection as from any point in the line RB produced, but as from a curve line passing through the several points F, f, f, &c.

Fig. 7. Had the curve BD been a hyperbola, having its foci in R and F, then R being the radiant (or the imaginary focus of incident rays), F would have been the focus of the reflected ones, and *vice versa*, however distant the points B and D might be taken from each other. In like manner, had the curve BD been an ellipse having its foci in F and R, the one of these being made the radiant (or imaginary focus of incident rays), the other would have been the focus of reflected ones, and *vice versa*. For both in the hyperbola and ellipse, lines drawn from each of their foci through any point make equal angles with the tangent to that point. Therefore, if the incident rays proceed to or from one of their foci, the reflected ones will all proceed as from or to the other focus. Therefore, in order that diverging or converging rays may be accurately reflected to or from a point, the reflecting surface must be formed by the revolution of an *hyperbola* about its longer axis, when the incident rays are such, that their radiant or imaginary focus of incident rays shall fall on one side of the surface, and the focus of the reflected ones on the other; when they are both to fall on the same side, it must be formed by the revolution of an *ellipse* abouti ts longer axis. However, as spherical surfaces are more easily formed, than those which are generated by the revolution of any of the conic sections about their axes, the latter are very rarely used.

Fig. 8.

176 Method of finding the focal distance of rays reflected from a convex surface. Now, because the focal distance of rays reflected from a spherical surface cannot be found by the analogy laid down in the third proposition, without making use of the quantity sought; we shall here give an example whereby the method of doing it in all others will readily appear.

PROBLEM.

Let it be required to find the focal distance of diverging rays incident upon a convex surface, whose radius of convexity is five parts, and the distance of the radiant from the surface is 20.

Call x the focal distance sought; then will the distance of the focus from the centre be $5-x$, and that of the radiant from the same 25, therefore by Prop. iii. we have the following proportion. $x : 20 = 5-x : 25$; and multiplying extremes together and means together, we have $25x = 100 - 20x$, or $x = \frac{100}{45}$.

If it should happen in any case that the value of x is a negative quantity, the focal point must then be taken on the contrary side of the surface to that on which it was supposed it would fall in stating the problem.

Because it was observed in the preceding section, that different incident rays, though tending to or from one point, would after refraction proceed to or from different points, a method was there given of determining the distinct point which each separate ray entering a spherical surface converges to, or diverges from, after refraction: the same has been observed here with regard to rays reflected from a spherical surface (see case 2. and case 10.) But the method of determining the distinct point to or from which any incident ray proceeds after reflection, is much more simple. It is only necessary to draw the reflected ray such, that the angle of reflection may be equal to the angle of incidence, which will determine the point it proceeds to or from in any case whatever. Appearance of Bodies seen by Reflection.

SECT. VIII. *Of the Appearance of Bodies seen by Light reflected from plane and spherical Surfaces.*

WHATEVER has been said concerning the appearance of bodies seen through lenses, by refracted light, respects also the appearance of bodies seen by reflection. But besides these, there is one thing peculiar to images by reflection, viz. that each point in the representation of an object made by reflection appears situated somewhere in a right line that passes through its correspondent point in the object, and is perpendicular to the reflecting surface.

The truth of this appears sufficiently from the propositions formerly laid down: in each of which, rays flowing from any radiant point, are shown to proceed after reflection to or from some point in a line that passes through the radiant point, and is perpendicular to the reflecting surface. For instance (fig. 1.), rays flowing from Y are collected in X, a point in the perpendicular CD, which, being produced, passes through Y; Plate CCCLXXXII. again (fig. 2.), rays flowing from G, proceed, after reflection, as from N, a point in the perpendicular CD, which, being produced, passes through G. Fig. 2.

This observation, however, except where an object is seen by reflection from a plain surface, relates only to those cases where the representation is made by means of such rays as fall upon the reflecting surface with a very small degree of obliquity; because such as fall at a considerable distance from the perpendicular, do not proceed after reflection as from any point in that perpendicular, but as from other points situated in a certain curve, on which account these rays are neglected, as making an indistinct and deformed representation. And therefore it is to be remembered, that however the situation of the eye with respect to the object and reflecting surface may be represented in the following figures, it is to be supposed as situated in such a manner with respect to the object, that rays flowing from thence and entering it after reflection, may be such only as fall with a very small degree of obliquity upon the surface; that is, the eye must be supposed to be placed almost directly behind the object, or between it and the reflecting surface. The reason why it is not always so placed, is only to avoid confusion in the figures.

I. *When an object is seen by reflection from a plane surface, the image of it appears at the same distance behind the surface that the object is before it, of the same magnitude, and directly opposite to it.*

To explain this, let AB represent an object seen by reflection from the plane surface SV; and let the rays AF, AG, be so inclined to the surface, that they shall enter an eye at H after reflection; and let AE be perpendicular to the surface: then, by the observation just mentioned, the point A will appear in some part of the line AE produced, suppose I; that is, the oblique rays 177 The appearance of objects reflected from plane surfaces. Fig. 10.

AF

Appearance of Bodies seen by Reflection from different Surfaces.

AF and AG will proceed after reflection as from that point; and further, because the reflected rays FH, GK, will have the same degree of inclination to one another that their incident ones have, that point must necessarily be at the same distance from the surface that the point A is; the representation therefore of the point A will be at the same distance from the surface that the point itself is before it, and directly opposite to it: consequently, since the like may be shown of any other point B, the whole image IM will appear at the same distance behind the surface that the object is before it, and directly opposite to it; and because the lines AI, BM, perpendicular to the plain surface, are parallel to each other, the image will also be of the same magnitude with the object

178 From convex surfaces.

II. *When an object is seen by reflection from a convex surface, its image appears nearer to the surface, and less than the object.*

Fig. 12.

Let AB represent the object, SV a reflecting surface whose centre of convexity is C: and let the rays AF, AG, be so inclined to the surface, that after reflection from it, they shall enter the eye at H: and let AE be perpendicular to the surface; then will the oblique rays AF, AG, proceed after reflection as from some point in the line AE produced, suppose from I; which point, because the reflected rays will diverge more than the incident ones, must be nearer to the surface than the point A. And since the same is also true of the rays which flow from any other B, the representation IM will be nearer to the surface than the object; and because it is terminated by the perpendiculars AE and BF, which incline to each other, as concurring at the centre, it will also appear less.

179 From concave surfaces.

III. *When an object is seen by reflection from a concave surface, the representation of it is various, both with regard to its magnitude and situation, according as the distance of the object from the reflecting surface is greater or less.*

1. When the object is nearer to the surface than its principal focus, the image falls on the opposite side of the surface, is more distant from it, and larger than the object.

Fig. 13.

Thus let AB be the object, SV the reflecting surface, F the principal focus, and C its centre. Through A and B, the extremities of the object, draw the lines CE, CR, which will be perpendicular to the surface; and let the rays AR, AG, be incident upon such points of it that they shall be reflected into an eye at H. Now, because the radiant points A and B are nearer the surface than the principal focus F, the reflected rays will diverge, and therefore proceed as from some points on the opposite side of the surface; which points, by the observation laid down at the beginning of this section, will be in the perpendiculars AE, BR, produced, suppose in I and M: but they will diverge in a less degree than their incident ones; and therefore the said points will be farther from the surface than the points A and B. The image therefore will be on the opposite side of the surface with respect to the object: it will be more distant than it; and consequently, being terminated by the perpendiculars CI and CM, it will also be larger.

2. When the object is placed in the principal focus, the reflected rays enter the eye parallel; in which case the image ought to appear at an infinite distance behind

the reflecting surface: but the representation of it, for the reasons given in the foregoing case, being large and distinct, we do not reckon it much farther from the surface than the image.

3. When the object is placed between the principal focus and the centre, the image falls on the opposite side of the centre, is larger than the object, and in an inverted position.

Plate CCCLXXXI. Fig. 14.

Thus let AB be the object, SV the reflecting surface, F its principal focus, and C its centre. Through A and B, draw the lines CE and CN, which will be perpendicular to the surface; and let AR, AG, be a pencil of rays flowing from A. These rays proceeding from a point beyond the principal focus, will after reflection converge towards some point on the opposite side the centre, which will fall upon the perpendicular EC produced, but at a greater distance from C than the radiant A from which they diverged. For the same reason, rays flowing from B will converge to a point in the perpendicular NC produced, which shall be farther from C than the point B; whence it is evident, that the image IM is larger than the object AB, that it falls on the contrary side of the centre, and that their positions are inverted with respect to each other.

4. If the object be placed beyond the centre of convexity, the image is then formed between the centre and the focus of parallel rays, is less than the object, and its position is inverted.

This proposition is the converse of the preceding; for as in that case rays proceeding from A were reflected to I, and from B to M; so rays flowing from I and M will be reflected to A and B: if therefore an object be supposed to be situated beyond the centre in IM, the image of it will be formed in AB between that and the focus of parallel rays, will be less than the object, and inverted.

5. If the middle of the object be placed in the centre of convexity of the reflecting surface, the object and its image will be coincident; but the image will be inverted with respect to the object.

That the place of the image and the object should be the same in this case requires little explication; for the middle of the object being in the centre, rays flowing from it will fall perpendicularly upon the surface, and therefore necessarily return thither again; so that the middle of the image will be coincident with the middle of the object. But that the image should be inverted is perhaps not so clear. To explain this, let AB be the object, having its middle point C in the centre of the reflecting surface from SV; through the centre and the point R draw the line CR, which will be perpendicular to the reflecting surface; join the points AR and BR, and let AR represent a ray flowing from A; this will be reflected into RB: for C being the middle point between A and B, the angle ARC=CRB; and a ray from B will likewise be reflected to A; and therefore the position of the image will be inverted with respect to that of the object. Fig. 15.

In this proposition it is to be supposed, that the object AB is so situated with respect to the reflecting surface, that the angle ACR may be right; for otherwise the angles ARC and BRC will not be equal, and part of the image only will therefore fall upon the object.

6. If

Appearance of Bodies seen by Reflection from different Surfaces.

6. If in any of the three last cases, in each of which the image is formed on the same side of the reflecting surface with the object, the eye be situated farther from the surface than the place where the image falls, the rays of each pencil, crossing each other in the several points of the image, will enter the eye as from a real object situated there; so that the image will appear pendulous in the air between the eye and the reflecting surface, and in the position wherein it is formed, viz. inverted with respect to the object, in the same manner that an image formed by refracted light appears to an eye placed beyond it; which was fully explained under Prop. iv. and therefore needs not be repeated.

But as what relates to the appearance of the object when the eye is placed nearer to the surface than the image, was not there fully inquired into, that point shall now be more strictly examined under the following case, which equally relates to refracted and reflected light.

7. If the eye be situated between the reflecting surface and the place of the image, the object is then seen beyond the surface; and the farther the eye recedes from the surface towards the place of the image, the more confused, larger, and nearer, the object appears.

Fig. 16.

To explain this, let AB represent the object; IM its image, one of whose points M is formed by the concurrence of the reflected rays DM, EM, &c. which before reflection came from B; the other, I, by the concurrence of DI, EI, &c. which came from A: and let *a b* be the pupil of an eye, situated between the surface DP and the image. This pupil will admit the rays H *a*, K *b*; which, because they are tending towards I, are such as came from A, and therefore the point A will appear diffused over the space RS. In like manner the pupil will also receive into it the reflected rays K *a* and L *b*, which, because they are tending towards M, by supposition came from B; and therefore the point B will be seen spread as it were over the space TV, and the object will seem to fill the space RV; but the representation of it will be confused, because the intermediate points of the object being equally enlarged in appearance, there will not be room for them between the points S and T, but they will coincide in part one with another: for instance, the appearance of that point in the object, whose representation falls upon *c* in the image, will fill the space *m n*; and so of the rest. Now, if the same pupil be removed into the situation *e f*, the reflected rays E *e* and G *f* will then enter the eye, and therefore one extremity of the object will appear to cover the space XY; and because the rays O *f* and L *e* will also enter it in their progress towards M, the point B, from which they came, will appear to cover ZV; the object therefore will appear larger and more confused than before. When the eye recedes quite to the image, it sees but one single point of the object, and that appears diffused all over the reflecting surface: for instance, if the eye recedes to the point M, then rays flowing from the point B enter it upon whatever part of the surface they fall. The object also appears nearer to the surface the farther the eye recedes from it towards the place of the image; probably because, as the appearance of the object becomes more and more confused, its place is not so easily distinguished from that of the reflecting surface itself, till at last when it is quite confused (as it is when the eye is arrived at M) they both appear as one, the surface assuming the colour of the object.

As to the precise apparent magnitude of an object seen after this manner, it is such that the angle it appears under shall be equal to that which the image of the same object would appear under were we to suppose it seen from the same place: that is, the apparent object (for such we must call it, to distinguish it from the image of the same object) and the image subtend equal angles at the eye.

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The apparent magnitude of an object seen by reflection from a concave surface.

Here we must suppose the pupil of the eye to be a point only, because the magnitude of it causes a small alteration in the apparent magnitude of the object. Let the point *a* represent the pupil, then will the extreme rays that can enter it be H *a* and K *a*; the object therefore will appear under the angle H *a* K = M *a* I, the angle under which the image IM would appear were it to be seen from *a*. Again, If the eye be placed in *f*, the object appears under the angle G *f* O = I *f* M, which the image subtends at the same place, and therefore the apparent object and image of it subtend equal angles at the eye.

Now if we suppose the pupil to have any sensible magnitude *a b*; then the object seen by the eye in that situation will appear under the angle HXL, which is larger than the angle H *a* K, under which it appeared before; because the angle at X is nearer than the angle at *a*, to the line IM, which is a subtense common to them both.

From this proposition it follows; that, were the eye close to the surface at K, the real and apparent object would be seen under equal angles (for the real object appears from that place under the same angle that the image does, as will be shown at the end of this section); therefore, when the eye is nearer to the image than that point, the image will subtend a larger angle at it than the object does; and consequently, since the image and apparent object subtend equal angles at the eye, the apparent object must necessarily be seen under a larger angle than the object itself, wherever the eye be placed, between the surface and the image.

As each point in the representation of an object made by reflection is situated somewhere in a right line that passes through its correspondent point in the object, and is perpendicular to the reflecting surface; we may hence deduce the following easy and expeditious method of determining both the magnitude and situation of the image in all cases whatever.

Plate CCCLXXXII. Fig. 17, 18, 19.

Through the extremities of the object AB and the centre C (fig. 17, 18, 19.) draw the lines AC BC, and produce them as the case requires; these lines will be perpendicular to the reflecting surface, and therefore the extremities of the image will fall upon them. Through F the middle point of the object and the centre, draw the line FC, and produce it till it passes through the reflecting surface; this will also be perpendicular to the surface. Through G, the point where this line cuts the surface, draw the lines AG and BG, and produce them this way or that, till they cross the former perpendiculars; and where they cross, there I and M the extremities of the image will fall. For supposing AG to be a ray proceeding from the point A and

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and falling upon G, it will be reflected to B; because FA=FB, and FG is perpendicular to the reflecting surface; and therefore the representation of the point A will be in LG produced as well as in AC; consequently it will fall on the point I, where they cross each other. Likewise the ray BG will for the same reason be reflected to A; and therefore the representation of the point B will be in AG produced, as well as in some part of BC, that is, in M where they cross. Hence the proposition is obvious.

If it happens that the lines will not cross which way soever they are produced, as in fig. 20. then is the object in the focus of parallel rays of that surface, and has no image formed in the place whatever. For in this case the rays AH, AG, flowing from the point A, become parallel after reflection in the lines HC, GB, and therefore do not flow as to or from any point: in like manner, rays flowing from B are reflected into the parallel lines KB and GA; so that no representation can be formed by such reflection.

From this we learn another circumstance relating to the magnitude of the image made by reflection; viz. that it subtends the same angle at the vertex of the reflecting surface that the object does. This appears by inspection of the 17th, 18th, or 19th figure, in each of which the angle IGM=AGB, the angles which the image subtends at G the vertex of the reflecting surface, and which the object subtends at the same place; for in the two first of those figures they are vertical, in the third they are the same.

The angle ICM, which the image subtends at the centre, is also equal to the angle ACB which the object subtends at the same place; for in the two first figures they are the same, in the last they are vertical to each other.

Whence it is evident, that the object and its image are to each other in diameter, either as their respective distances from the vertex of the reflecting surface, or as their distances from the centre of the same.

IV. *As objects are multiplied by being seen through transparent media, whose surfaces are properly disposed, so they may also by reflecting surfaces.*

Plate CCCLXXXII. Fig. 21.

1. If two reflecting surfaces be disposed at right angles, as the surfaces AB, BC, an object at D may be seen by an eye at E, after one reflection at F, in the line EF produced; after two reflections, the first at G, the second at H, in the line EH produced; and also, after one reflection made at A, in the line EA produced.

Fig. 22.

2. If the surfaces be parallel, as AB, CD, (fig. 22.), and the object be placed at E and the eye at F, the object will appear multiplied an infinite number of times: thus it may be seen in the line FG produced, after one reflection at G; in the line FH produced, after two reflections, the first at I, the second at H; and also in FP produced, after several successive reflections of the ray EL, at the points L, M, N, O, and P: and so on *in infinitum*. But the greater the number of reflections are, the weaker their representation will be.

Sect. IX. *Of the apparent Place, Distance, Magnitude, and Motion of Objects.*

Apparent place, &c. of objects.

It had in general been taken for granted, that the place to which the eye refers any visible object seen by reflection or refraction, is that in which the visual rays meet a perpendicular from the object upon the reflecting or refracting plane. But this method of judging of the place of objects was called in question by Dr Barrow, who contended that the arguments brought in favour of the opinion were not conclusive. These arguments are, that the images of objects appeared straight in a plane miror, but curved in a convex or concave one: that a straight thread, when partly immersed perpendicularly in water, does not appear crooked as when it is obliquely plunged into the fluid; but that which is within the water seems to be a continuation of that which is without. With respect to the reflected image, however, of a perpendicular right line from a convex or concave mirror, he says, that it is not easy for the eye to distinguish the curve that it really makes; and that if the appearance of a perpendicular thread, part of which is immersed in water, be closely attended to, it will not favour the common hypothesis. If the thread is of any shining metal, as silver, and viewed obliquely, the image of the part immersed will appear to detach itself sensibly from that part which is without the water, so that it cannot be true that every object appears to be in the same place where the refracted ray meets the perpendicular; and the same observation, he thinks, may be extended to the case of reflection. According to Dr Barrow, we refer every point of an object to the place from which the pencils of light, that give us the image of it, issue, or from which they would have issued if no reflecting or refracting substance intervened. Pursuing this principle, he proceeds to investigate the the place in which the rays issuing from each of the points of an object, and which reach the eye after one reflection or refraction, meet; and he found, that if the refracting surface was plane, and the refraction was made from a denser medium into a rarer, those rays would always meet in a place between the eye and a perpendicular to the point of incidence. If a convex mirror be used, the case will be the same; but if the mirror be plane, the rays will meet in the perpendicular, and beyond it if it be concave. He also determined, according to these principles, what form the image of a right line will take, when it is presented in different manners to a spherical mirror, or when it is seen through a refracting medium.

181
Dr Barrow's theory respecting the apparent place of objects.

Though Dr Barrow reckoned the maxim which he endeavoured to establish, concerning the supposed place of visible objects, highly probable, he has the candour to mention an objection to it, of which he was not able to give a satisfactory solution. It is this. Let an object be placed beyond the focus of a convex lens; and if the eye be close to the lens, it will appear confused, but very near to its true place. If the eye be a little withdrawn, the confusion will increase, and the object will seem to come nearer; and when the eye is near the focus, the confusion will be exceedingly great, and the object will seem to be close to the eye. But in this experiment the eye receives no rays but those that are converging: and the point from which they issue is so far from being nearer than the object, that it is beyond it; notwithstanding which, the object is conceived to be much nearer than it is, though no very distinct idea can be formed of its precise distance. It may be observed, that in reality, the rays falling upon the eye in this case in

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in a manner quite different from that in which they fall upon it in other circumstances, we can form no judgement about the place from which they issue. This subject was afterwards taken up by Berkeley, Smith, Montucla, and others.

182 M. de la Hire's observations.

M. de la Hire made several observations concerning the distance of visible objects, and various other phenomena of vision, which are worthy of notice. He also took particular pains to ascertain the manner in which the eye conforms itself to the view of objects placed at different distances. He enumerates five circumstances, which assist us in judging of the distance of objects, namely their apparent magnitude, the strength of the colouring, the direction of the two eyes, the parallax of the objects, and the distinctness of their small parts. Painters, he says, can only take advantage of the two first-mentioned circumstances, and therefore pictures can never perfectly deceive the eye; but in the decorations of theatres, they, in some measure, make use of them all. The size of objects, and the strength of their colouring, are diminished in proportion to the distance at which they are intended to appear. Parts of the same object which are to appear at different distances, as columns in an order of architecture, are drawn upon different planes a little removed from one another, that the two eyes may be obliged to change their direction, in order to distinguish the parts of the nearer plane from those of the more remote. The small distance of the planes serves to make a small parallax, by changing the position of the eye; and as we do not preserve a distinct idea of the quantity of parallax, corresponding to the different distances of objects, it is sufficient that we perceive there is a parallax, to be convinced that these planes are distant from one another, without determining what that distance is; and as to the last circumstance, viz. the distinctness of the small parts of objects, it is of no use in discovering the deception, on account of the false light that is thrown upon these decorations.

183 M. le Cat's account of the largeness of objects in mist.

To these observations concerning deception of sight, we shall add a similar one of M. le Cat, who took notice that the reason why we imagine objects to be larger when they are seen through a mist, is the dimness or obscurity with which they are then seen; this circumstance being associated with the idea of great distance. This, he says, is confirmed by our being surprised to find, upon approaching such objects, that they are so much nearer to us, as well as so much smaller, than we had imagined.

Among other cases concerning vision, which fell under the consideration of M. de la Hire, he mentions one which it is difficult to solve. It is when a candle, in a dark place, and situated beyond the limits of distinct vision, is viewed through a very narrow chink in a card; in which case a considerable number of candles, sometimes so many as six, will be seen along the chink. This appearance he ascribes to small irregularities in the surface of the humours of the eye, the effect of which is not sensible when rays are admitted into the eye through the whole extent of the pupil, and consequently one principal image effaces a number of small ones; whereas, in this case, each of them is formed separately, and no one of them is so considerable as to prevent the others from being perceived at the same time.

There are few persons, M. de la Hire remarks, who have both their eyes exactly equal, not only with respect to the limits of distinct vision, but also with regard to the colour with which objects appear tinged when they are viewed by them, especially if one of the eyes has been exposed to the impression of a strong light. To compare them together in this respect, he directs us to take two thin cards, and to make in each of them a round hole of a third or a fourth of a line in diameter, and, applying one of them to each of the eyes, to look through the holes on a white paper, equally illuminated, when a circle of the paper will appear to each of the eyes, and, placing the cards properly, these two circles may be made to touch one another, and thereby the appearance of the same object to each of the eyes may be compared to the greatest advantage. To make this experiment with exactness, it is necessary, he says, that the eyes be kept shut some time before the cards be applied to them.

By the following calculation, M. de la Hire gives us an idea of the extreme sensibility of the optic nerves. One may see very easily, at the distance of 4000 toises, the sail of a wind mill, 6 feet in diameter; and the eye being supposed to be an inch in diameter, the picture of this sail, at the bottom of the eye, will be $\frac{1}{8000}$ of an inch, which is less than the 666th part of a line, and is about the 66th part of a common hair, or the 8th part of a single thread of silk. So small, therefore, must one of the fibres of the optic nerve be, which, he says, is almost inconceiveable, since each of these fibres is a tube that contains spirits.

184 Berkeley's account of the judgement formed concerning distance by confused vision.

The person who particularly noticed Dr Barrow's hypothesis was the ingenious Dr Berkeley, bishop of Cloyne, who distinguished himself so much by the objections which he started to the reality of a material world, and by his opposition to the Newtonian doctrine of fluxions. In his Essay towards to a new Theory of Vision, he observes, that the circle formed upon the retina, by the rays which do not come to a focus, produce the same confusion in the eye, whether they cross one another before they reach the retina, or tend to do it afterwards; and therefore that the judgement concerning distance will be the same in both the cases, without any regard to the place from which the rays originally issued; so that in this case, as, by receding from the lens, the confusion, which always accompanies the nearness of an object, increases, the mind will judge that the object comes nearer.

185 Smith's account.

But, says Dr Smith, if this be true, the object ought always to appear at a less distance from the eye than that at which objects are seen distinctly, which is not the case: and to explain this appearance, as well as every other in which a judgement is formed concerning distance, he maintains, that we judge of it chiefly if not only by the apparent magnitude of objects, so that, since the image grows larger as we recede from the lens through which it is viewed, we conceive the object to come nearer. He also endeavours to show, that in all cases in which glasses are used, we judge of distance by the same rule; from which he concludes, that the apparent distance of an object seen in a glass is to its apparent distance seen by the naked eye, as the apparent magnitude in the naked eye is to its apparent magnitude in the glass.

But that we do not judge of distance merely by the angle

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angle under which objects are seen, is an observation as old as Alhazen, who mentions several instances, in which, though the angles under which objects appear be different, the magnitudes are universally and instantaneously deemed not to be so. Mr Robins clearly shows the hypothesis of Dr Smith to be contrary to fact in the most common and simple cases. In microscopes, he says, it is impossible that the eye should judge the object to be nearer than the distance at which it has viewed the object itself, in proportion to the degree of magnifying. For when the microscope magnifies much, this rule would place the image at a distance, of which the sight cannot possibly form any opinion, as being an interval from the eye at which no object can be seen. In general, he says, he believes, that whoever looks at an object through a convex glass, and then at the object itself without the glass, will find it to appear nearer in the latter case, though it be magnified in the glass; and in the same trial with the concave glass, though by the glass the object be diminished, it will appear nearer through the glass than without it.

186 Objected to by Mr Robins.

But the following experiment is the most convincing proof that the apparent distance of the image is not determined by its apparent magnitude. If a double convex glass be held upright before some luminous object, as a candle, there will be seen two images, one erect, and the other inverted. The first is made simply by reflection from the nearest surface, the second by reflection from the farther surface, the rays undergoing a refraction from the first surface both before and after the reflection. If this glass has not too short a focal distance when it is held near the object, the inverted image will appear larger than the other, and also nearer; but if the glass be carried off from the object, though the eye remain as near to it as before, the inverted image will diminish so much faster than the other, that, at length, it will appear very much less than it, but still nearer. Here, says Mr Robins, two images of the same object are seen under one view, and their apparent distances, when immediately compared, seem to have no necessary connexion with the apparent magnitude. He also shows how this experiment may be made still more convincing, by sticking a piece of paper on the middle of the lens, and viewing it through a short tube.

187 M. Bouguer adopts Dr Barrow's maxim.

M. Bouguer adopts the general maxim of Dr Barrow, in supposing that we refer objects to the place from which the pencils of rays seemingly converge at their entrance into the pupil. But when rays issue from below the surface of a vessel of water, or any other refracting medium, he finds that there are always two different places of this seeming convergence; one of them of the rays that issue from it in the same vertical circle, and therefore fall with different degrees of obliquity upon the surface of the refracting medium; and another, of those that fall upon the surface with the same degree of obliquity, entering the eye laterally with respect to one another. Sometimes, he says, one of these images is attended to by the mind, and sometimes the other, and different images may be observed by different persons. An object immersed in water affords an example, he says, of this duplicity of images.

Plate CCLXXIV. Fig. 1.

If BAb be part of the surface of water, and the object be at O, there will be two images of it in two different places; one at G, on the caustic by refraction, and the other at E, in the perpendicular AO, which is as much a caustic as the other line. The former image is visible by the rays ODM, Odm, which are one higher than the other, in their progress to the eye; whereas the image at E is made by the rays ODM, Oef, which enter the eye laterally. This, says he, may serve to explain the difficulty of Father Tacquet, Barrow, Smith, and many other authors.

G. W. Kraft has ably supported the opinion of Dr Barrow, that the place of any point, seen by reflection from the surface of any medium, is that in which rays issuing from it, infinitely near to one another, would meet; and considering the case of a distant object, viewed in a concave mirror, by an eye very near to it, when the image, according to Euclid and other writers would be between the eye and the object, and the rule of Dr Barrow cannot be applied; he says that in this case the speculum may be considered as a plane, the effect being the same, only the image is more obscure.

Dr Porterfield gives a distinct view of the natural methods of judging concerning the distance of objects.

188 Dr Porterfield's view of the subject.

The conformation of the eye, he observes, can be of no use to us with respect to objects placed without the limits of distinct vision. As the object, however, does then appear more or less confused, according as it is more or less removed from those limits, this confusion assists the mind in judging of the distance of the object; it being always estimated so much the nearer, or the farther off, as the confusion is greater. But this confusion hath its limits also; for when an object is placed at a certain distance from the eye, to which the breadth of the pupil bears no sensible proportion, the rays of light that come from a point in the object, and pass the pupil, are so little diverging, that they may be considered as parallel. For a picture on the retina will not be sensibly more confused, though the object be removed to a much greater distance.

The most general, and frequently the most certain means of judging of the distance of objects is, he says, by the angle made by the optic axis. For our two eyes are like two different stations, by the assistance of which distances are taken; and this is the reason why those persons who are blind of one eye, so frequently miss their marks in pouring liquor into a glass, snuffing a candle, and such other actions as require that the distance be exactly distinguished. To be convinced of the utility of this method of judging of the distance of objects, he directs us to suspend a ring in a thread, so that its side may be towards us, and the hole in it to the right and left hand; and taking a small rod, crooked at the end, retire from the ring two or three paces, and having with one hand covered one of our eyes, to endeavour with the other to pass the crooked end of the rod through the ring. This, says he, appears very easy; and yet, upon trial, perhaps once in 100 times we shall not succeed, especially if we move the rod a little quickly.

The use of this second method of judging of distances Dechales limited to 120 feet; beyond which, he says, we are not sensible of any difference in the angle of the optic axis.

A third method of judging of the distance of objects, consists in their apparent magnitudes, on which so much stress was laid by Dr Smith. From this change in the magnitude

Apparent place, &c. of objects.

magnitude of the image upon the retina, we easily judge of the distance of objects, as often as we are otherwise acquainted with their magnitude; but as often as we are ignorant of the real magnitude of bodies, we can never, from their apparent magnitude, form any judgement of their distance.

Hence we may see why we are so frequently deceived in our estimates of distance, by any extraordinary magnitudes of objects seen at the end of it; as, in travelling towards a large city, or a castle, or a cathedral church, or a mountain larger than common, we fancy them to be nearer than they really are. This also is the reason why animals, and little objects, seen in valleys, contiguous to large mountains, appear exceedingly small. For we think the mountain nearer to us than if it were smaller; and we should not be surprised at the smallness of the neighbouring animals, if we thought them farther off. For the same reason, we think them exceedingly small, when they are placed upon the top of a mountain, or a large building; which appear nearer to us than they really are, on account of their extraordinary size.

189 Why objects seen from a high building appear smaller than they are.

Dr Jurin accounts for our imagining objects, when seen from a high building, to be smaller than they are, and smaller than we fancy them to be when we view them at the same distance on level ground. It is, says he, because we have no distinct idea of distance in that direction, and therefore judge of things by their pictures upon the eye only; but custom will enable us to judge rightly even in this case.

Let a boy, says he, who has never been upon any high building, go to the top of a lofty spire, and look down into the street; the objects seen there, as men and horses, will appear so small as greatly to surprise him. But 10 or 20 years after, if in the mean time he has used himself now and then to look down from that and other great heights, he will no longer find the same objects to appear so small. And if he were to view the same objects from such heights as frequently as he sees them upon the same level with himself in the streets, he supposes that they would appear to him just of the same magnitude from the top of the spire, as they do from a window one story high. For this reason it is, that statues placed upon very high buildings ought to be made of a larger size than those which are seen at a nearer distance; because all persons, except architects, are apt to imagine the height of such buildings to be much less than it really is.

The fourth method by which Dr Porterfield says that we judge of the distance of objects, is the force with which their colour strikes upon our eyes. For if we be assured that two objects are of a similar and like colour, and that one appears more bright and lively than the other, we judge that the brighter object is the nearer of the two.

The fifth method consists in the different appearance of the small parts of objects. When these parts appear distinct, we judge that the object is near; but when they appear confused, or when they do not appear at all, we reckon the object to be at a greater distance. For the image of any object, or part of an object, diminishes as its distance increases.

The sixth and last method by which we judge of the distance of objects is, that the eye does not represent to our mind one object alone, but at the same time all those that are placed betwixt us and the principal object, whose distance we are considering; and the more this distance is divided into separate and distinct parts, the greater it appears to be. For this reason, distances upon uneven surfaces appear less than upon a plane: for the inequalities of the surfaces, such as hills, and holes, and rivers, that lie low and out of sight, either do not appear, or hinder the parts that lie behind them from appearing; and so the whole apparent distance is diminished by the parts that do not appear in it. This is the reason that the banks of a river appear contiguous to a distant eye, when the river is low and not seen.

190 Several fallacies of vision explained.

Dr Porterfield very well explains several fallacies in vision which depend upon our mistaking the distances of objects. Of this kind, he says, is the appearance of parallel lines, and long vistas consisting of parallel rows of trees; for they seem to converge more and more as they are farther extended from the eye. The reason of this, he says, is because the apparent magnitudes of their perpendicular intervals are perpetually diminishing, while, at the same time, we mistake their distance. Hence we may see why, when two parallel rows of trees stand upon an ascent, whereby the more remote parts appear farther off than they really are, because the line that measures the length of the vistas now appears under a greater angle than when it was horizontal, the trees, in such a case, will seem to converge less, and sometimes, instead of converging, they will be thought to diverge.

For the same reason that a long vista appears to converge more and more the farther it is extended from the eye, the remoter parts of a horizontal walk or a long floor will appear to ascend gradually; and objects placed upon it, the more remote they are the higher they will appear, till the last be seen on a level with the eye; whereas the ceiling of a long gallery appears to descend towards a horizontal line, drawn from the eye of the spectator. For this reason, also, the surface of the sea, seen from an eminence, seems to rise higher and higher the farther we look; and the upper parts of high buildings seem to stoop, or incline forwards over the eye below, because they seem to approach towards a vertical line proceeding from the spectator's eye; so that statues on the top of such buildings, in order to appear upright, must recline, or bend backwards.

Dr Porterfield also shows the reason why a windmill, seen from a great distance, is sometimes imagined to move the contrary way from what it really does, by our taking the nearer end of the sail for the more remote. The uncertainty we sometimes find in the course of the motion of a branch of lighted candles, turned round at a distance, is owing, he says, to the same cause; as also our sometimes mistaking a convex for a concave surface, more especially in viewing seals and impressions with a convex glass or a double microscope; and lastly, that, upon coming in a dark night into a street, in which there is but one row of lamps, we often mistake the side of the street they are on.

Far more light was thrown upon this curious subject by M. Bouguer.

The proper method of drawing the appearance of

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two rows of trees that shall appear parallel to the eye, is a problem which has exercised the ingenuity of several philosophers and mathematicians. That the apparent magnitude of objects decreases with the angle under which they are seen, has always been acknowledged. It is also acknowledged, that it is only by custom and experience that we learn to form a judgement both of magnitudes and distances. But in the application of these maxims to the above-mentioned problem, all persons, before M. Bouguer, made use of the real distance instead of the apparent one; by which only the mind can form its judgement. And it is manifest, that, if any circumstances contribute to make the distance appear otherwise than it is in reality, the apparent magnitude of the object will be affected by it; for the same reason, that, if the magnitude be misapprehended, the idea of the distance will vary.

191 Great light thrown upon this subject by M. Bouguer.

For want of attending to this distinction, Tacquet pretended to demonstrate, that nothing can give the idea of two parallel lines (rows of trees for instance) to an eye situated at one of their extremities, but two hyperbolical curves, turned the contrary way; and M. Varignon maintained, that in order to make a vista appear of the same width, it must be made narrower, instead of wider, as it recedes from the eye.

M. Bouguer observes, that very great distances, and those that are considerably less than they, make nearly the same impression upon the eye. We, therefore, always imagine great distances to be less than they are; and for this reason the ground plan of a long vista always appears to rise. The visual rays come in a determinate direction; but as we imagine that they terminate sooner than they do, we necessarily conceive that the place from which they issue is elevated. Every large plane, therefore, as AB, viewed by an eye at O, will seem to lie in such a direction as A b; and consequently lines, in order to appear truly parallel on the plane AB, must be drawn so as that they would appear parallel on the plane A d, and be from thence projected to the plane AB.

Plate CCCLXXXIV. Fig. 2.

To determine the inclination of the apparent ground-plan A d to the true ground-plan AB, our ingenious author directs us to draw upon a piece of level ground two straight lines of a sufficient length (for which purpose lines fastened to small sticks are very convenient), making an angle of 3 or 4 degrees with one another. Then a person, placing himself within the angle, with his back towards the angular point, must walk backwards and forwards till he can fancy the lines to be parallel. In this situation, a line drawn from the point of the angle through the place of his eye, will contain the same angle with the true ground-plan which this does with the apparent one.

M. Bouguer then shows other more geometrical methods of determining this inclination; and says; that by these means he has often found it to be 4 or 5 degrees, though sometimes only 2 or 2½ degrees. The determination of this angle, he observes, is variable; depending upon the manner in which the ground is illuminated and the intensity of the light. The colour of the soil is also not without its influence, as well as the particular conformation of the eye, by which it is more or less affected by the same degree of light, and also the part of the eye on which the object is painted. When, by a slight motion of his head, he contrived, that certain parts of the soil, the image of which fell towards the bottom of his eye, should fall towards the top of the retina, he always thought that this apparent inclination became a little greater.

But what is very remarkable, is, that if he look towards a rising ground, the difference between the apparent ground-plan and the true one will be much more considerable, so that they will sometimes make an angle of 25 or 30 degrees. Of this he had made frequent observations. Mountains, he says, begin to be inaccessible when their sides make an angle from 35 or 37 degrees with the horizon, as then it is not possible to climb them but by means of stones or shrubs, to serve as steps to fix the feet on. In these cases, both he and his companions always agreed that the apparent inclination of the side of the mountain was 60 or 70 degrees.

These deceptions are represented in fig. 3. in which, when the ground-plan AM, or AN, is much inclined, the apparent ground-plan A m, or A n, makes a very large angle with it. On the contrary, if the ground dips below the level, the inclination of the apparent to the true ground-plan diminishes, till, at a certain degree of the slope, it becomes nothing at all; the two plans AP and A p being the same, so that parallel lines drawn upon them would always appear so. If the inclination below the horizon is carried beyond the situation AP, the error will increase; and what is very remarkable, it will be on the contrary side; the apparent plan A r being always below the true plan AR, so that if a person would draw upon the plan AR lines that shall appear parallel to the eye, they must be drawn converging, and not diverging, as is usual on the level ground; because they must be the projections of two lines imagined to be parallel, on the plan A r, which is more inclined to the horizon than AR.

Plate CCCLXXXIV. Fig. 3.

These remarks, he observes, are applicable to different planes exposed to the eye at the same time. For if BH, fig. 4. be the front of a building, at the distance of AB from the eye, it will be reduced in appearance to the distance A b; and the front of the building will be $b\,h$, rather inclined towards the spectator, unless the distance be inconsiderable.

Fig. 4.

After making a great number of observations upon this subject, our author concludes, that when a man stands upon a level plane, it does not seem to rise sensibly but at some distance from him. The apparent plane, therefore, has a curvature in it, at that distance, the form of which is not very easy to determine; so that a man standing upon a level plane, of infinite extent, will imagine that he stands in the centre of a bason. This is also, in some measure, the case with a person standing upon the level of the sea.

He concludes with observing, that there is no difficulty in drawing lines according to these rules, so as to have any given effect upon the eye, except when some parts of the prospect are very near the spectator, and others very distant from him, because, in this case, regard must be had to the conical or conoidal figure of a surface. A right line passing at a small distance from the observer, and below the level of his eye, in that case almost always appears sensibly curved at a certain distance from the eye; and almost all figures in this case are subject to some complicated optical alteration to which the rules of perspective have not as yet been extended. If a circle be drawn near our feet, and within that

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that part of the ground which appears level to us, it will always appear to be a circle, and at a very considerable distance it will appear an ellipse; but between these two situations, it will not appear to be either the one or the other, but will be like one of those ovals of Descartes, which is more curved on one of its sides than the other.

On these principles a parterre, which appears distorted when it is seen in a low situation, appears perfectly regular when it is viewed from a balcony or any other eminence. Still, however, the apparent irregularity takes place at a greater distance, while the part that is near the spectator is exempt from it. If AB, fig. 5. be the ground-plan, and A *a* be a perpendicular, under the eye, the higher it is situated, at O, to the greater distance will T, the place at which the plane begins to have an apparent ascent along T *b*, be removed.

Fig. 5.

192 Visible motion of objects.

All the varieties that can occur with respect to the visible motion of objects, are thus succinctly summed up by Dr Porterfield under eleven heads.

1. An object moving very swiftly is not seen, unless it be very luminous. Thus a cannon ball is not seen if it is viewed transversely: but if it be viewed according to the line it describes, it may be seen, because its picture continues long on the same place of the retina; which, therefore, receives a more sensible impression from the object.

2. A live coal swung briskly round in a circle appears a continued circle of fire, because the impressions made on the retina by light, being of a vibrating, and consequently of a lasting nature, do not presently perish, but continue till the coal performs its whole circuit, and returns again to its former place.

3. If two objects, unequally distant from the eye, move with equal velocity, the more remote one will appear the slower; or, if their celerities be proportional to their distances, they will appear equally swift.

4. If two objects, unequally distant from the eye, move with unequal velocities in the same direction, their apparent velocities are in a ratio compounded of the direct ratio of their true velocities, and the reciprocal one of their distances from the eye.

5. A visible object moving with any velocity appears to be at rest, if the space described in the interval of one second be imperceptible at the distance of the eye. Hence it is that a near object moving very slowly, as the index of a clock, or a remote one very swiftly, as a planet, seems to be at rest.

6. An object moving with any degree of velocity will appear at rest, if the space it runs over in a second of time be to its distance from the eye as 1 to 1400.

7. The eye proceeding straight from one place to another, a lateral object, not too far off, whether on the right or left, will seem to move the contrary way.

8. The eye proceeding straight from one place to another, and being sensible of its motion, distant objects will seem to move the same way, and with the same velocity. Thus, to a person running eastwards, the moon on his right hand appears to move the same way, and with equal swiftness; for, on account of its distance, its image continues fixed upon the same place of the retina, from whence we imagine that the object moves along with the eye.

9. If the eye and the object move both the same way, only the eye much swifter than the object, the last will appear to go backwards.

10. If two or more objects move with the same velocity, and a third remain at rest, the moveable ones will appear fixed, and the quiescent one in motion the contrary way. Thus when clouds move very swiftly, their parts seem to preserve their situation, and the moon to move the contrary way.

11. If the eye be moved with great velocity, lateral objects at rest appear to move the contrary way. Thus to a person sitting in a coach, and riding briskly through a wood, the trees seem to retire the contrary way; and to people in a ship, &c. the shores seem to recede.

193 Dr Porterfield's account of objects appearing to move to a giddy person when he and they are both at rest.

At the conclusion of these observations, Dr Porterfield endeavours to explain another phenomenon of motion, which, though common and well known, had not been explained in a satisfactory manner. It is this: If a person turns swiftly round, without changing his place, all objects about will seem to move round in a circle the contrary way; and this deception continues not only while the person himself moves round, but, which is more surprising, it also continues for some time after he ceases to move, when the eye, as well as the object, is at absolute rest.

The reason why objects appear to move round the contrary way, when the eye turns round, is not so difficult to explain: for though, properly speaking, motion is not seen, as not being in itself the immediate object of sight; yet by the sight we easily know when the image changes its place on the retina, and thence conclude that either the object, the eye, or both, are moved. But by the sight alone we can never determine how far this motion belongs to the object, how far to the eye, or how far to both. If we imagine the eye at rest, we ascribe the whole motion to the object, though it be truly at rest. If we imagine the object at rest, we ascribe the whole motion to the eye, though it belongs entirely to the object; and when the eye is in motion, though we are sensible of its motion, yet, if we do not imagine that it moves so swiftly as it really does, we ascribe only a part of the motion to the eye, and the rest of it we ascribe to the object, though it be actually at rest. This last, he says, is what happens in the present case, when the eye turns round; for though we are sensible of the motion of the eye, yet we do not apprehend that it moves so fast as it really does; and therefore the bodies about appear to move the contrary way, as is agreeable to experience.

But the great difficulty still remains, viz. Why, after the eye ceases to move, objects should, for some time, still appear to continue in motion, though their pictures on the retina be really at rest, and do not at all change their place. This, he imagined, proceeds from a mistake we are in with respect to the eye, which, though it be absolutely at rest, we nevertheless conceive as moving the contrary way to that in which it moved before; from which mistake, with respect to the motion of the eye, the objects at rest will appear to move the same way which the eye is imagined to move; and, consequently, will seem to continue their motion for some time after the eye is at rest.

194 Dr Wells accounts for this phenomenon.

This is ingenious, but perhaps not just. An account of this matter, which seems to us more satisfactory,

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tory, has been lately given to the public by Dr Wells. "Some of the older writers upon optics (says this ingenious philosopher) imagined the visive spirits to be contained in the head, as water is in a vessel; which, therefore, when once put in motion by the rotation of our bodies, must continue in it for some after this has ceased; and to this real circular movement of the visive spirits, while the body is at rest, they attributed the apparent motions of objects in giddiness. Dechales saw the weakness of this hypothesis; and conjectured, that the phenomenon might be owing to a real movement of the eyes; but produced no fact in proof of his opinion. Dr Porterfield, on the contrary, supposed the difficulty of explaining it to consist in showing, why objects at rest appear in motion to an eye which is also at rest. The solution he offered of this representation of the phenomenon, is not only extremely ingenious, but is, I believe, the only probable one which can be given. It does not apply, however, to the fact which truly exists; for I shall immediately show, that the eye is not at rest, as he imagined. The last author I know of who has touched upon this subject is Dr Darwin. His words are, 'When any one turns round rapidly on one foot till he becomes dizzy, and falls upon the ground, the spectra of the ambient objects continue to present themselves in rotation, or appear to librate, and he seems to behold them for some time in motion.' I do not indeed pretend to understand his opinion fully; but this much seems clear, that if such an apparent motion of the surrounding objects depends in any way upon their spectra, or the illusive representations of those objects, occasioned by their former impressions upon the retinas, no similar motion would be observed, were we to turn ourselves round with our eyes shut, and not to open them till we became giddy; for in this case, as the surrounding objects could not send their pictures to the retinas, there would consequently be no spectra to present themselves afterward in rotation. But whoever will make the experiment, will find, that objects about him appear to be equally in motion, when he has become giddy by turning himself round, whether this has been done with his eyes open or shut. I shall now venture to propose my own opinion upon this subject.

195 Upon what data we judge visible objects to be in motion or at rest.

"If the eye be at rest, we judge an object to be in motion when its picture falls in succeeding times upon different parts of the retina; and if the eye be in motion, we judge an object to be at rest, as long as the change in the place of its picture upon the retina holds a certain correspondence with the change of the eye's position. Let us now suppose the eye to be in motion, while, from some disorder in the system of sensation, we are either without those feelings which indicate the various positions of the eye, or are not able to attend to them. It is evident, that in such a state of things an object at rest must appear to be in motion, since it sends in succeeding times its picture to different parts of the retina. And this seems to be what happens in giddiness. I was first led to think so from observing, that, during a slight fit of giddiness I was accidentally seized with, a coloured spot, occasioned by looking steadily at a luminous body, and upon which I happened at that moment to be making an experiment, was moved in a manner altogether independent of the positions I conceived my eyes to possess. To determine this point, I again produced the spot, by looking some time at the flame of a candle: then turning myself round till I became giddy, I suddenly discontinued this motion, and directed my eyes to the middle of a sheet of paper, fixed upon the wall of my chamber. The spot now appeared upon the paper, but only for a moment; for it immediately after seemed to move to one side, and the paper to the other, notwithstanding I conceived the position of my eyes to be in the mean while unchanged. To go on with the experiment, when the paper and spot had proceeded to a certain distance from each other, they suddenly came together again; and this separation and conjunction were alternately repeated a number of times, the limits of the separation gradually becoming less, till at length the paper and spot both appeared to be at rest, and the latter to be projected upon the middle of the former. I found also, upon repeating and varying the experiment a little, that when I had turned myself from left to right, the paper moved from right to left, and the spot consequently the contrary way; but that when I had turned from right to left, the paper would then move from left to right. These were the appearances observed while I stood erect. When I inclined, however, my head in such a manner as to bring the side of my face parallel to the horizon, the spot and paper would then move from each other, one upward and the other downward. But all these phenomena demonstrate, that there was a real motion in my eyes at the time I imagined them to be at rest; for the apparent situation of the spot, with respect to the paper, could not possibly have been altered, without a real change of the position of those organs. To have the same thing proved in another way, I desired a person to turn quickly round, till he became very giddy; then to stop himself, and look stedfastly at me. He did so, and I could plainly see, that although he thought his eyes were fixed, they were in reality moving in their sockets, first toward one side and then toward the other."

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196 Curious experiments to ascertain this.

197 A remarkable deception explained by M. le Cat. Plate CCCLXXXIV. Fig. 6.

M. Le Cat well explains a remarkable deception, by which a person shall imagine an object to be on the opposite side of a board, when it is not so, and also inverted and magnified. It is illustrated by fig. 6. in which D represents the eye, and CB a large black board, pierced with a small hole. E is a large white board, placed beyond it, and strongly illuminated; and *d* a pin, or other small object, held betwixt the eye and the first board. In these circumstances, the pin shall be imagined to be at F, on the other side of the board, where it will appear inverted and magnified; because what is in fact perceived, is the shadow of the pin upon the retina; and the light that is stopped by the upper part of the pin coming from the lower part of the enlightened board, and that which is stopped by the lower part coming from the upper part of the board, the shadow must necessarily be inverted with respect to the object. This is nothing more than Mr Grey's experiment, in which he saw an inverted image of the pin, and which we have already noticed.

There is a curious phenomenon relating to vision, which some persons have ascribed to the inflection of light, but which Mr Melville explains in a very different and very simple manner.

198 A curious phenomenon explained by Mr Melville.

When any opaque body is held at the distance of three or four inches from the eye, so that a part of some more distant luminous object, such as the window, or the flame of a candle, may be seen by rays passing near its edge,

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edge, if another opaque body, nearer to the eye, be brought across from the opposite side, the edge of the first body will seem to swell outwards, and meet the latter; and in doing so will intercept a portion of the luminous object that was seen before.

This appearance he explains in the following manner: Fig. 7. Let AB represent the luminous object to which the sight is directed, CD the more distant opaque body, GH the nearer, and EF the diameter of the pupil. Join ED, FD, EG, FG, and produce them till they meet AB in K, N, M, and L. It is plain that the parts AN, MB, of the luminous object cannot be seen. But taking any point a between N and K, and drawing a D d, since the portion d F of the pupil is filled with light flowing from that point, it must be visible. Any point b, between a and K, must fill f F, a greater portion of the pupil, and therefore must appear brighter. Again, Any point c between b and K, must appear brighter than b, because it fills a greater portion g F with light. The point K itself, and every other point in the space KL, must appear very luminous, since they send entire pencils of rays EKF, ELF, to the eye; and the visible brightness of every point from L towards M, must decrease gradually, as from K to N, that is, the spaces KN, LM, will appear as dim shadowy borders, or fringes, adjacent to the edges of the opaque bodies.

When the edge G is brought to touch the right line KF, the penumbras unite; and as soon as it reaches NDF, the above phenomenon begins; for it cannot pass that right line without meeting some line a D d, drawn from a point between N and K, and, by intercepting all the rays that fall upon the pupil, render it invisible. In advancing gradually to the line KDE, it will meet other lines b D f, c D g, &c. and therefore render the points b, c, &c. from N to K, successively invisible; and therefore the edge of the fixed opaque body CD must seem to swell outwards, and cover the whole space NK; while GH, by its motion, covers MK. When GH is placed at a greater distance from the eye, CD continuing fixed, the space OP to be passed over in order to intercept NK is less; and therefore, with an equal motion of GH, the apparent swelling of CD must be quicker; which is found true by experience.

If ML represent a luminous object, and REFQ any plane exposed to its light, the space FQ will be entirely shaded from the rays, and the space FE will be occupied by a penumbra, gradually darker, from E to F. Let now GH continue fixed, and CD move parallel to the plane EF; and as soon as it passes the line LF, it is evident that the shadow QF will seem to swell outwards; and when CD reaches ME, so as to cover with its shadow the space RE, QF, by its extension, will cover FE. This is found to hold true likewise by experiment.

Sect. X. *On Aberration of Figure or Sphericity.*

199 Theory of aberration.

The great practical use of the science of optics is to aid human sight; but it has been repeatedly observed during the progress of this article, that in constructing dioptrical instruments for this purpose, great difficulties arise from the aberration of light. It has been shown how to determine the concourse of any refracted ray PF' with the ray RVCF', which passes through the centre C, and therefore falls perpendicularly on the spherical surface at the vertex V, and suffers no refraction. This is the conjugate focus to R for the two rays RP, RV, and for another ray flowing from R and falling on the surface at an equal distance on the opposite side to P. In short, it is the conjugate focus for all the rays flowing from R and falling on the spherical surface in the circumference of a circle described by the revolution of the point P round the axis RVCF; that is, of all the rays which occupy the conical surface described by the revolution of RP, and the refracted rays occupy the conical surface produced by the revolution of PF'.

Plate cclxxviii. Figs. 5, 6, &c.

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But no other rays flowing from R are collected at F'; for it appeared in the demonstration of that proposition, that rays incident at a greater distance from the axis RC were collected at a point between C and F'; and then the rays which are incident on the whole arch PC, or the spherical surface generated by its revolution round RC, although they all cross the axis RC, are diffused over a certain portion of it, by what has been called the aberration of figure. It is called also (but improperly) the aberration from the geometrical focus, by which is meant the focus of an infinitely slender pencil of rays, of which the middle ray (or axis of the pencil) occupies the lens RC, and suffers no refraction. But there is no such focus. But if we make mRV—nRC : mRV=VC : VF, the point F is called the geometrical focus, and is the remotest limit from C of all the foci (equally geometrical) of rays flowing from R. The other limit is easily determined by constructing the problem for the extreme point of the given arch.

It is evident from the construction, that while the point of incidence P is near to V, the line CK increases but very little, and therefore CF diminishes little, and the refracted rays are but little diffused from F; and therefore they are much denser in its vicinity than any other point of the axis. It will soon be evident that they are incomparably denser. It is on this account that the point F has been called the conjugate focus to R, and the geometrical focus, and the diffusion has been called *aberration*. A geometrical point R is thus represented by a very small circle at F, and F has drawn the chief attention. And as, in the performance of optical instruments, it is necessary that this extended representation of a mathematical point R be very small, that it may not sensibly interfere with the representations of the points adjacent to R, and thus cause indistinct vision, a limit is thus set to the extent of the refracting surface which must be employed to produce this representation. But this evidently diminishes the quantity of light, and renders the vision *obscure* though distinct. Artists have therefore endeavoured to execute refracting surfaces of forms not spherical, which collect accurately to one point the light issuing from another, and the mathematicians have furnished them with forms having this property: but their attempts have been fruitless. Spherical surfaces are the only ones which can be executed with accuracy. All are done by grinding the refracting substance in a mould of proper materials. When this is spherical, the two work themselves, with moderate attention, into an exact sphere; because if any part is more prominent than another, it is ground away, and the whole gets of necessity one curvature. And it is astonishing to what degree of accuracy this is done. An error of the millionth part of an inch would totally destroy

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ſtroy the figure of a mirror of an inch focal diſtance, ſo as to make it uſeleſs for the coarſeſt inſtrument. Therefore all attempts to make other figures are given up. Indeed other reaſons make them worſe than ſpherical, even when accurately executed. They would not collect to accurate focuſes the rays of oblique pencils.

It is evident from theſe obſervations, that the theory of aberrations is abſolutely neceſſary for the ſucceſsful conſtruction of optical inſtruments; and it muſt be acceptable to the reader to have a ſhort account of it in this place. Enough ſhall be ſaid here to ſhow the *general* nature and effects of it in optical inſtruments, and in ſome of the more curious phenomena of nature. Under the article TELESCOPE the ſubject will be reſumed, in ſuch a manner as to enable the reader who poſſeſſes a very moderate ſhare of mathematical knowledge, not only to underſtand how aberrations are increaſed and diminiſhed, but alſo how, by a proper employment of contrary aberrations, their hurtful effects may be *almoſt entirely* removed in all important caſes. And the manner in which the ſubject ſhall be treated in the preſent general ſketch, will have the advantage of pointing out at the ſame time the maxims of conſtruction of the greateſt part of optical inſtruments, which generally produce their effects by means of pencils of rays which are either out of the axis altogether, or are oblique to it; caſes which are ſeldom conſidered in elementary treatiſes of optics.

Plate CCCLXXXIV. Fig. 1.

Let PVπ be a ſpherical ſurface of a refracting ſubſtance (glaſs for inſtance), of which C is the centre, and let an indefinitely ſlender pencil of rays APap be incident on it, in a direction parallel to a ray CV paſſing through the centre. It is required to determine the focus f of this pencil.

200 How to remedy the evils of aberration.

Let AP be refracted into PF. Draw CI, CR the ſines of incidence and refraction, and CP the radius. Draw RB perpendicular to CP, and Bf parallel to AP or CV. I ſay, firſt, f is the focus of the indefinitely ſlender pencil, or, more accurately ſpeaking, f is the remoteſt limit from P of the concourſe of rays with PF' refracted by points lying without the arch VP, or the neareſt limit for rays incident between V and P.

Draw the radius Cpc', the line pf; and draw pg parallel to Pf, and Po perpendicular to Pf. It is evident, that if f be the focus, $c'pf$ is the angle of refraction correſponding to the angle of incidence, apC as C'Pf is the angle correſponding to APC. Alſo PCp is the increment of the angle of incidence, and the angle $c'pg$ is equal to the ſum of the angle C'Pf and C'Cc, and the angle gpf is equal to the angle pfP. Therefore $c'pf$=C'Pf+P, Cp, +Pfp. Therefore PCp+Pfp is the correſponding increment of the angle of refraction. Alſo, becauſe RPo=CPp (being right angles) the angle pPo=RPC, and Po : Pp= PR : PC.

Therefore by a preceding Lemma in this article, we have PCp+Pfp : PCp=tan. ref. : tan. incid.= T, R : T, I; and Pfp : PCp=T, R—T, I : T, I, =diff. : T, I; but Pfp : PCp=$\frac{\mathrm{P}o}{\mathrm{P}f}:\frac{\mathrm{P}p}{\mathrm{P}c}=\frac{\mathrm{PR}}{\mathrm{P}f}:\frac{\mathrm{PC}}{\mathrm{PC'}}$ =PR : Pf,=DR : DB (becauſe DP is parallel to Bf by conſtruction)=tan. CPR—tan. CPI : tan. CPI. Now CPI is the angle of incidence; and therefore CPR is the angle properly correſponding to it as an angle of refraction, and the point f is properly determined.

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Hence the following rule. *As the difference of the tangents of incidence and refraction is to the tangent of incidence, ſo is the radius of the ſurface multiplied by the coſine of refraction to the diſtance of the focus of an infinitely ſlender pencil of parallel incident rays.*

N. B. We here conſider the coſine of refraction as a number. This was firſt done by the celebrated Euler, and is one of the greateſt improvements in mathematics which this century can boaſt of. The ſines, tangents, ſecants, &c. are conſidered as fractional numbers, of which the radius is unity. Thus, CP × ſin. 30°, is the ſame thing with $\frac{1}{2}$ CP, or $\frac{\mathrm{CP}}{2}$. And in like manner, CB, drawn perpendicular to the axis × ſin. 19° 28′ 16″ 32‴, is the ſame thing with $\frac{1}{3}$ of CB. Alſo $\frac{\mathrm{CB}}{\text{coſ. } 60^\circ}$ is the ſame thing with twice CB, &c.

In this manner, BE=BC × ſin. BCE, and alſo BE =CE × tan. BCE, and CB=CE × ſec. BCE, &c. &c. This manner of conſidering the lines which occur in geometrical conſtructions is of immenſe uſe in all parts of mixed mathematics; and nowhere more remarkably than in optics, the moſt beautiful example of them. Of this an important inſtance ſhall now be given.

COR. 1. The diſtance fG of this lateral focus from the axis CV (that is, from the line drawn through the centre parallel to the incident light) is proportional to the cube of the ſemi-aperture PH of the ſpherical ſurface.

For fG=BE. Now BE=CB × ſin. BCE, =CB × ſin. CPA; and CB=RC × coſ. RCB, =RC × ſin. CPR, and RC=CP × ſin. CPR: Therefore BE=PC × ſin.^{2} CPR × ſin. PCA, =PC × ſin.^{2} refr. × ſin. incid. but ſin.^{2} refr.=$\frac{m^2}{n^2}$ſin.^{2} incid. Therefore, finally, BE, or fG=PC × $\frac{m^2}{n^2}$ × ſin.^{3} incid.: But PC, ſin. incid. is evidently PH the ſemi-aperture; therefore the propoſition is manifeſt.

COR. 2. Now let this ſlender pencil of rays be incident at the vertex V. The focus will now be a point F in the axis, determined by making CV : CF=m—n : m. Let the incident pencil gradually recede from the axis CF, ſtill, however, keeping parallel to it. The focus f will always be found in a curve line DC'F, ſo conſtituted that the ordinate G will be as the cube of the line PH, perpendicular to the axis intercepted between the axis and that point of the ſurface which is cut by a tangent to the curve in f.

All the refracted rays will be tangents to this curve, and the adjacent rays will croſs each other in theſe lateral foci f; and will therefore be incomparably more denſe along the curve than anywhere within its area. This is finely illuſtrated by receiving on white paper the light of the ſun refracted through a globe or cylinder of glaſs filled with water. If the paper is held parallel to the axis of the cylinder, and cloſe to it, the illuminated part will be bounded by two very bright parallel lines, where it is cut by the curve; and theſe lines will gradually approach each other as the paper is withdrawn from the veſſel, till they coaleſce into one very bright

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bright line at F, or near it. If the paper be held with its end touching the veffel, and its plane nearly perpendicular to the axis, the whole progrefs of the curve will be diftinctly feen.

As fuch globes were ufed for burning glaffes, the point of greateft condenfation (which is very near but not exactly in F) was called the *focus*. When thefe curves were obferved by Mr Tchirnhaufs, he called them *cauftics*; and thofe formed by refraction he called *diacauftics*, to diftinguifh them from the *catacauftics* formed by reflection.

It is fomewhat furprifing, that thefe curves have been fo little ftudied fince the time of Tchirnhaufs. The doctrine of aberrations has indeed been confidered in a manner independent on their properties. But whoever confiders the progrefs of rays in the eye-piece of optical inftruments, will fee that the knowledge of the properties of diacauftic curves determines directly, and almoft accurately, the foci and images that are formed there. For, let the object-glafs of a telefcope or microfcope be of any dimenfions, the pencils incident on the eye-glaffes are almoft all of this evanefcent bulk. Thefe advantages will be fhown in their proper places: and we proceed at prefent to extend our knowledge of aberrations in general, firft confidering the aberrations of parallel incident rays.

Abiding by the inftance reprefented by the figure, it is evident that the cauftic will touch the furface in a point φ, fo fituated that $c\varphi : \varphi\chi = m : n$. The refracted ray $\varphi\Phi$ will touch the furface, and will crofs the axis in Φ, the neareft limit of diffufion along the axis. If the furface is of fmaller extent, as PV, the cauftic begins at f, when the extreme refracted ray Pf touches the cauftic, and croffes the axis in F', and the oppofite branch of the cauftic in K. If there be drawn an ordinate KOk to the cauftic, it is evident that the whole light incident on the furface PVΠ paffes through the circle whofe diameter is Kk, and that the circle is the fmalleft fpace which receives *all* the refracted light.

201 How light is diftributed over the fmalleft circle of diffufion.

It is of great importance to confider the manner in which the light is diftributed over the furface of this circle of fmalleft diffufion: for this is the reprefentation of one point of the infinitely diftant radiant object. Each point of a planet, for inftance, is reprefented by this little circle; and as the circles reprefenting the different adjacent points muft interfere with each other, an indiftinctnefs muft arife fimilar to what is obferved when we view an object through a pair of fpectacles which do not fit the eye. The indiftinctnefs muft be in proportion to the number of points whofe circles of diffufion interfere; that is, to the area of thefe circles, provided that the light is uniformly diffufed over them: but if it be very rare at the circumference, the impreffion made by the circles belonging to the adjacent points muft be lefs fenfible. Accordingly, Sir Ifaac Newton, fuppofing it incomparably rarer at the circumference than towards the centre, affirms that the indiftinctnefs of telefcopes, arifing from the fpherical figure of the object-glafs, was fome thoufand times lefs than that arifing from the unequal refrangibility of light; and therefore, that the attempts to improve them by diminifhing or removing this aberration were needlefs, while the indiftinctnefs from unequal refrangibility remained. It is furprifing, that a philofopher fo eminent for fagacity and for mathematical knowledge fhould have made fuch a miftake, and unfortunate that the authority of his great name hindered others from examining the matter, trufting to his affertion that the light was fo rare at the border of this circle. His miftake is furprifing, becaufe the very nature of a cauftic fhould have fhowed him that the light was infinitely denfe at the borders of the circle of fmalleft diffufion. The firft perfon who detected this overfight of the Britifh philofopher was the Abbé Bofcovich, who, in a differtation publifhed at Vienna in 1767, fhowed, by a very beautiful analyfis, that the diftribution was extremely different from what Newton had afferted, and that the fuperior indiftinctnefs arifing from unequal refragibility was incomparably lefs than he had faid. We fhall attempt to make this delicate and interefting matter conceived by thofe who have but fmall mathematical preparation.

Plate CCCLXXXVI. Fig. 2.

Let the curve DVZCI$c\,z\,v\,d$ be the cauftic (magnified), EI its axis, I the focus of central rays, B the focus of extreme rays, and IB the line containing the foci of all the intermediate rays, and COc the diameter of the circle of fmalleft diffufion.

It is plain, that from the centre O there can be drawn two rays OV, Ov, touching the cauftic in V, v. Therefore the point O will receive the ray EO, which paffes through the vertex of the refracting furface, and all the rays which are incident on the circumference of a circle defcribed on the refracting furface by the extremity of the ray OV, or Ov. The denfity of the light at O will therefore be indefinitely great.

From the point C there can be drawn two rays; one of them CX touching the cauftic in C, and the other C, touching it at d on the oppofite fide. The rays which touch the cauftic in the immediate vicinity of Cy, both in the arch CV and the arch CI will cut OC in points indefinitely near to each other; becaufe their diftance from each other in the line OC will be to their uniform diftance on the refracting furface as the diftance between their points of contact with the cauftic to the diftance of thefe points from the refracting furface. Here therefore at C the denfity of the light will alfo be indefinitely great.

From any point H, lying between O and C, may be drawn three rays. One of them LHT, P, touching the arch CD of the cauftic in T, cutting the refracting furface in P, and the axis in L: another tHp, touching the arch CI of the cauftic in t. The third is H$\tau\pi$, touching the arch $c\,d$ of the oppofite branch of the cauftic in τ.

It will greatly affift our conception of this fubject, Fig. 1. if we confider a ray of light from the refracting furface as a thread attached at I of this figure, or at F of fig. 1. and gradually unlapped from the cauftic DVCI on one fide, and then lapped on the oppofite branch I$c\,v\,d$; and attend to the point of its interfection with the diameter cOC of the circle of fmalleft diffufion.

Therefore, 1. Let the ray be firft fuppofed to pafs through the refracting furface at F, the right hand extremity of the aperture. The thread is then folded up on the whole right hand branch ICVD of the cauftic; and if the ftraight part of it FD be produced, it will cut the diameter of the circle of fmalleft diffufion in the oppofite extremity c. Or fuppofe a ruler in place of the thread, applied to the cauftic at D and to the refracting furface at F, the part of it Dc, which

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which is detached from the cauftic, cuts Oc in the point c. 2. Now fuppofe the ruler to revolve gradually, its extremity moving acrofs the arch FAf of the refracting furface while the edge is applied to the cauftic; the point of contact with the cauftic will fhift gradually down the branch DV of the cauftic, while its edge paffes acrofs the line c C; and when the point of contact arrives at V, the extremity will be at Y on the refracting furface, and the interfection of the edge will be at O. 3. Continuing the motion, the point of contact fhifts from V to Z, the extremity from Y to Q', and the interfection from O to Q, fo that $OQ^2 = \frac{OC^2}{2}$, as will prefently appear. 4. After this, the point of contact will fhift from Z to C, the extremity from Q' to X, halfway from F to A, as will foon be fhown, and the interfection from Q to C. 5. The point of contact will now fhift from C down to I, the extremity will pafs from X to A, and the interfection will go back from C to O. 6. The ruler muft now be applied to the other branch of the cauftic I $czvd$, and the point of contact will afcend from I to c, the extremity will pafs from A to x, half way to f from A, and the interfection from O to c, 7. The point of contact will afcend from C to z, the extremity paffes from x to q', and the interfection from C to q, Oq^2 being $= \frac{Oc^2}{2}$. 8. While the contact of the ruler and cauftic fhifts from z to v, the extremity fhifts from q' to y, and the interfection from q to O. 9. The contact rifes from v to d, the extremity paffes from y to f, and the interfection from O to C; and then the motion acrofs the refracting furface is completed: the point of contact fhifting down from D to I along the branch DVZCI, and then afcending along the other branch I $c z v d$, while the interfection paffes from c to C, back again from C to c, and then back again from c to C, where it ends, having thrice paffed through every intermediate point of c C.

202 Denfity of light.

We may form a notion of the denfity of the light in any point H, by fuppofing the incident light of uniform denfity at the refracting furface, and attending to the conftipation of the rays in the circle of fmalleft diffufion. Their vicinity may be eftimated both in the direction of the radii OH, and in the direction of the circumference defcribed by its extremity H, during its revolution round the axis; and the denfity muft be conceived as proportional to the *number* of originally equidiftant rays, which are collected into a fpot of given area. Thefe have been collected from a correfponding fpot or area of the refracting furface; and as the number of rays is the fame in both, the denfity at H will be to the denfity of the refracting furface, as the area occupied of the refracting furface to the correfponding area at H. The vicinity of the rays in the direction of the radius depends on the proportion between PT and TH. For the ray adjacent to PTH may be fuppofed to crofs it at the point of contact T; and therefore the uniform diftance between them at the furface of that medium is to the diftance between the fame rays at H as the diftance of T from the refracting furface to its diftance from H. Therefore the number of rays which occupy a tenth of an inch, for example, of the radius AP, is to the number which would occupy a tenth of an inch at H as TH to TP; and the radial denfity at P is to the radial denfity at H, alfo as TH to TP. In the next place, The circumferential denfity at P is to that at H as the radius AP to the radius OH. For fuppofing the figure to turn round its axis AI, the point P of the refracting furface will defcribe a circumference whofe radius is AP, and H will defcribe a circumference whofe radius is OH; and the whole rays which pafs through the firft circumference pafs alfo through the laft, and therefore their circumferential denfities will be in the inverfe proportion of the fpaces into which they are collected. Now the radius AP is to the radius OH as AL to OL; and circumferences have the fame proportion with their radii. Therefore the circumferential denfity at P is to that in H as AL to OL inverfely; and it was found that the radial denfity was as AN to ON inverfely, being as TH to TP, which are very nearly in this ratio. Therefore the abfolute denfity (or number of rays collected in a given fpace) at P will be to that at H, in the ratio compounded of thefe ratios; that is, in the ratio of $ON \times OL$ to $AN \times AL$. But as NL bears but a very fmall ratio to AN or AL, $AN \times AL$ may be taken as equal to AO^2 without any fenfible error. It never differs from it in telefcopes 100th part, and is generally incomparably fmaller. Therefore the denfity at H may be confidered as proportional to $ON \times OL$ inverfely. And it will afterwards appear that NS is $= 3oL$. Therefore the denfity at H is inverfely as $ON \times NS$.

Now defcribe a circle on the diameter OS, and draw $NT\varphi$ cutting the circumference $N\varphi^2 = ON \times NS$, and the denfity at H is as $N\varphi^2$ inverfely. This gives us a very eafy eftimation of the denfity, viz. draw a line from the point of contact of the ray which touches the part VC of the cauftic, and the denfity is in the inverfe fubduplicate ratio of the part of this line intercepted between the axis and the circumference $S\varphi O$. It will afterwards appear that the denfity correfponding to this ray is one half of the denfity correfponding to all the three: or a better expreffion will be had for the denfity at H by drawing $R\beta$ perpendicular to $R\varphi$, and βo perpendicular to $\varphi\beta$, making φR in o; then φo is as $\frac{1}{\varphi N^2}$, or is proportional to the denfity, as is evident.

When H is at O, N is at S, and φo is infinite. As H moves from O, N defcends, and φo diminifhes, till H comes to Q, and T to z, and φ to ζ, and o to R. When H moves from Q towards C, T defcends below z, φo again increafes, till it is again infinite, when H is at C, T at C, and N at O.

Thus it appears, without any minute confideration, that the light has a denfity indefinitely great in the centre O; that the denfity decreafes to a minimum in fome intermediate point Q, and then increafes again to infinity at the margin C. Hence it follows, that the indiftinctnefs arifing from the fpherical figure of the refracting furfaces is incomparably greater than Newton fuppofed; and that the valuable difcovery of Mr Dollond of achromatic lenfes, muft have failed of anfwering his fond expectations, if his very method of producing them had not, at the fame time, enabled him to remove that other indiftinctnefs by employing contrary aberrations. And now, fince the difcovery by Dr Blair of fubftances which difperfe the different colours in the fame proportions, but very different degrees, Of Aberration. grees, has enabled us to employ much larger portions of the ſphere than Mr Dollond could introduce into his object-glaſſes, it becomes abſolutely neceſſary to ſtudy this matter completely, in order to diſcover and aſcertain the amount of the errors which perhaps unavoidably remain.

203 Contrary aberrations correct each other. This ſlight ſketch of the moſt ſimple caſe of aberration, namely, when the incident rays are parallel, will ſerve to give a general notion of the ſubject; and the reader can now ſee how contrary aberrations may be employed in order to form an ultimate image which ſhall be as diſtinct as poſſible. For let it be propoſed to converge parallel rays accurately to the focus F by the refraction of ſpherical ſurfaces of which V is the vertex. Let PV be a convex lens of ſuch a form that rays flowing from F and paſſing through it immediately round the vertex V are collected to the conjugate focus R, while the extreme ray FP, incident on the margin of the lens P, is converged to r, nearer to V, having the longitudinal aberration Rr. Let pV be a plano-concave lens, of ſuch ſphericity that a ray Ap, parallel to the axis CV, and incident on the point p, as far from its vertex V as P in the other lens is from its vertex, is diſperſed from r, the diſtance ϱ V being equal to τ V, while the central rays are diſperſed from P, as far from V as R is from V. It is evident, that if theſe lenſes be joined as in fig. 4. a ray A'p, parallel to the common axis CV, will be collected at the diſtance VF equal to VF in the fig. 4. and that rays paſſing through both lenſes in the neighbourhood of the axis will be collected at the ſame point F. (Plate CCLXXXVI. Fig. 3.)

This compound lens is ſaid to be without ſpherical aberration; and it is true that the central and the extreme rays are collected in the ſame point F: but the rays which fall on the lens between the centre and margin are a little diffuſed from F, and it is not poſſible to collect them all to one point. For in the rules for computing the aberration, quantities are neglected which do not preſerve, in different apertures, the ſame ratio to the quantities retained. The diffuſion is leaſt when the aberration is corrected, not for the very extremity, but for a certain intermediate point (varying with the aperture, and having no known ratio to it); and when this is done the compound lens is in its ſtate of greateſt perfection, and the remaining aberration is quite inſenſible. See TELESCOPE.

SECT. VI. *On the different Refrangibility of Light.*

As this property of light ſolves a great number of the phenomena which could not be underſtood by former opticians, we ſhall give an account of it nearly in the words of Sir Iſaac Newton, who firſt diſcovered it; eſpecially as his account is more full and perſpicuous than thoſe of ſucceeding writers.

Plate CCLXXXIII. Fig. 1. "In a dark chamber, at a round hole F, about one third of an inch broad, made in the ſhutter of a window, I placed a glaſs priſm ABC, whereby the beam of the ſun's light, SF, which came in at that hole, might be refracted upwards, toward the oppoſite wall of the chamber, and there form a coloured image of the ſun, repreſented at PT. The axis of the priſm was, in this and the following experiments, perpendicular to the incident rays. About this axis I turned the priſm ſlowly, and ſaw the refracted or coloured image of the ſun, firſt to deſcend, and then to aſcend. Between the deſcent and aſcent, when the image ſeemed ſtationary, I ſtopped the priſm and fixed it in that poſture. (On the different refrangibility of Light.)

"Then I let the refracted light fall perpendicularly upon a ſheet of white paper, MN, placed at the oppoſite wall of the chamber, and obſerved the figure and dimenſions of the ſolar image, PT, formed on the paper by that light. This image was oblong, and not oval, but terminated by two rectilinear and parallel ſides and two ſemicircular ends. On its ſides it was bounded pretty diſtinctly; but on its ends very indiſtinctly, the light there vaniſhing by degrees. At the diſtance of $18\frac{1}{2}$ feet from the priſm the breadth of the image was about $2\frac{1}{8}$ inches, but its length was about $10\frac{1}{4}$ inches, and the length of its rectilinear ſides about 8 inches; and ACB, the refracting angle of the priſm, by which ſo great a length was made, was 64 degrees. With a leſs angle the length of the image was leſs, the breadth remaining the ſame. It is farther to be obſerved, that the rays went on in ſtraight lines from the priſm to the image, and therefore at their going out of the priſm had all that inclination to one another from which the length of the image proceeded. This image PT was coloured, and the more eminent colours lay in this order from the bottom at T to the top at P; red, orange, yellow, green, blue, indigo, violet; together with all their intermediate degrees in a continual ſucceſſion perpetually varying."

204 Light conſiſts of ſeveral ſorts of coloured rays differently refrangible. Our author concludes from this and other experiments, "that the light of the ſun conſiſts of a mixture of ſeveral ſorts of coloured rays, ſome of which at equal incidences are more refracted than others, and therefore are called *more refrangible*. The red at T, being neareſt to the place Y, where the rays of the ſun would go directly if the priſm was taken away, is the leaſt refracted of all the rays; and the orange, yellow, green, blue, indigo, and violet, are continually more and more refracted, as they are more and more diverted from the courſe of the direct light. For by mathematical reaſoning he has proved, that when the priſm is fixed in the poſture above mentioned, ſo that the place of the image ſhall be the loweſt poſſible, or at the limit between its deſcent and aſcent, the figure of the image ought then to be round like the ſpot at Y, if all the rays that tended to it were equally refracted. Therefore, ſince it is found by experience that this image is not round, but about five times longer than broad, it follows, that all the rays are not equally refracted. This concluſion is farther confirmed by the following experiments.

Fig. 2. "In the ſunbeam SF, which was propagated into the room through the hole in the window-ſhutter EG, at the diſtance of ſome feet from the hole, I held the priſm ABC in ſuch a poſture, that its axis might be perpendicular to that beam: then I looked through the priſm upon the hole F, and turning the priſm to and fro about its axis to make the image pt of the hole aſcend and deſcend, when between its two contrary motions it ſeemed ſtationary, I ſtopped the priſm; in this ſituation of the priſm, viewing through it the ſaid hole E, I obſerved the length of its refracted image pt to be many times greater than its breadth; and that the moſt refracted part thereof appeared violet at p; the leaſt refracted, at t; and the middle parts indigo, blue, green,

yellow,

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yellow, and orange, in order. The ſame thing happened when I removed the priſm out of the ſun's light, and looked through it upon the hole ſhining by the light of the clouds beyond it. And yet if the refractions of all the rays were equal according to one certain proportion of the ſines of incidence and refraction, as is vulgarly ſuppoſed, the refracted image ought to have appeared round, by the mathematical demonſtration above mentioned. So then by theſe two experiments it appears, that in equal incidences there is a conſiderable inequality of refractions."

For the diſcovery of this fundamental property of light, which has unfolded the whole myſtery of colours, we ſee our author was not only beholden to the experiments themſelves, which many others had made before him, but alſo to his ſkill in geometry; which was abſolutely neceſſary to determine what the figure of the refracted image ought to be upon the old principle of an equal refraction of all the rays: but having thus made the diſcovery, he contrived the following experiment to prove it at ſight.

Plate CCCLXXXIII. Fig. 3.

"In the middle of two thin boards, DE*de*, I made a round hole in each, at G and *g*, a third part of an inch in diameter; and in the window-ſhut a much larger hole being made, at F, to let into my darkened chamber a large beam of the ſun's light, I placed a priſm, ABC, behind the ſhut in that beam, to refract it towards the oppoſite wall; and cloſe behind this priſm I fixed one of the boards DE, in ſuch a manner that the middle of the refracted light might paſs through the hole made in it at G, and the reſt be intercepted by the board. Then at the diſtance of about 12 feet from the firſt board, I fixed the other board, *de*, in ſuch manner that the middle of the refracted light, which came through the hole in the firſt board, and fell upon the oppoſite wall, might paſs through the hole *g* in this other board *de*, and the reſt being intercepted by the board, might paint upon it the coloured ſpectrum of the ſun. And cloſe behind this board I fixed another priſm *abc*, to refract the light which came through the hole *g*. Then I returned ſpeedily to the firſt priſm ABC, and by turning it ſlowly to and fro about its axis, I cauſed the image which fell upon the ſecond board *de*, to move up and down upon that board, that all its parts might paſs ſucceſſively through the hole in that board, and fall upon the priſm behind it. And in the mean time I noted the places, *M*, *N*, on the oppoſite wall, to which that light after its refraction in the ſecond priſm did paſs; and by the difference of the places at *M* and *N*, I found that the light, which being moſt refracted in the firſt priſm ABC, did go to the blue end of the image, was again more refracted by the ſecond priſm *abc*, than the light which went to the red end of that image. For when the lower part of the light which fell upon the ſecond board *de*, was caſt through the hole *g*, it went to a lower place M on the wall; and when the higher part of that light was caſt through the ſame hole *g*, it went to a higher place N on the wall; and when any intermediate part of the light was caſt through that hole, it went to ſome place in the wall between M and N. The unchanged poſition of the holes in the boards made the incidence of the rays upon the ſecond priſm to be the ſame in all caſes. And yet in that common incidence ſome of the rays were more refracted and others leſs: and thoſe were more refracted in this priſm, which by a greater refraction in the firſt priſm were more turned out of their way; and therefore, for their conſtancy of being more refracted, are deſervedly called *more refrangible*."

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205 Reflected light differently refrangible.

Sir Iſaac ſhows alſo, by experiments made with convex glaſs, that lights, reflected from natural bodies, which differ in colour, differ alſo in refrangibility; and that they differ in the ſame manner as the rays of the ſun do.

Fig. 4.

"The ſun's light conſiſts of rays differing in reflexibility, and thoſe rays are more reflexible than others which are more refrangible. A priſm, ABC, whoſe two angles, at its baſe BC, were equal to one another and half right ones, and the third at A a right one, I placed in a beam FM of the ſun's light, let into a dark chamber through a hole F one third part of an inch broad. And turning the priſm ſlowly about its axis until the light which went through one of its angles ACB, and was refracted by it to G and H, began to be reflected into the line MN by its baſe BC, at which till then it went out of the glaſs; I obſerved that thoſe rays, as MH, which had ſuffered the greateſt refraction, were ſooner reflected than the reſt. To make it evident that the rays which vaniſhed at H were reflected into the beam MN, I made this beam paſs through another priſm VXY, and being refracted by it to fall afterwards upon a ſheet of white paper *pt* placed at ſome diſtance behind it, and there by that refraction to paint the uſual colours at *pt*. Then cauſing the firſt priſm to be turned about its axis according to the order of the letters ABC, I obſerved, that when thoſe rays MH, which in this priſm had ſuffered the greateſt refraction, and appeared blue and violet, began to be totally reflected, the blue and violet light on the paper which was moſt refracted in the ſecond priſm received a ſenſible increaſe at *p*, above that of the red and yellow at *t*: and afterwards, when the reſt of the light, which was green, yellow, and red, began to be totally reflected and vaniſhed at G, the light of thoſe colours at *t*, on the paper *pt*, received as great an increaſe as the violet and blue had received before. Which puts it paſt diſpute, that thoſe rays became firſt of all totally reflected at the baſe BC, which before at equal incidences with the reſt upon the baſe BC had ſuffered the greateſt refraction. I do not here take any notice of any refractions made in the ſides AC, AB, of the firſt priſm, becauſe the light enters almoſt perpendicularly at the firſt ſide, and goes out almoſt perpendicularly at the ſecond; and therefore ſuffers none, or ſo little, that the angles of incidence at the baſe BC are not ſenſibly altered by it; eſpecially if the angles of the priſm at the baſe BC be each about 40 degrees. For the rays FM begin to be totally reflected when the angle CMF is about 50 degrees, and therefore they will then make a right angle of 90 degrees with AC.

"It appears alſo from experiments, that the beam of light MN, reflected by the baſe of the priſm, being augmented firſt by the more refrangible rays and afterwards by the leſs refrangible, is compoſed of rays differently refrangible.

"The light whoſe rays are all alike refrangible, I call *ſimple*, *homogeneous*, and *ſimilar*; and that whoſe rays are ſome more refrangible than others, I call *compound*, *heterogeneous*, and *diſſimilar*. The former light I call *homogeneous*, not becauſe I would affirm it ſo in all reſpects;

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ſpects; but becauſe the rays which agree in refrangibility agree at leaſt in all their other properties which I conſider in the following diſcourſe.

206 Colours ſimple or compound

"The colours of homogeneous lights I call *primary*, *homogeneous*, and *ſimple*; and thoſe of heterogeneous lights, *heterogeneous* and *compound*. For theſe are always compounded of homogeneous lights, as will appear in the following diſcourſe.

"The homogeneous light and rays which appear red, or rather make objects appear ſo, I call *rubrific* or *red-making*; thoſe which make objects appear yellow, green, blue, and violet, I call *yellow-making*, *blue-making*, *violet-making*; and ſo of the reſt. And if at any time I ſpeak of light and rays as coloured or endowed with colours, I would be underſtood to ſpeak not philoſophically and properly, but groſsly, and according to ſuch conceptions as vulgar people in ſeeing all theſe experiments would be apt to frame. For the rays, to ſpeak properly, are not coloured. In them there is nothing elſe than a certain power and diſpoſition to ſtir up a ſenſation of this or that colour. For as ſound, in a bell or muſical ſtring or other ſounding body, is nothing but a trembling motion, and in the air nothing but that motion propagated from the object, and in the ſenſorium it is a ſenſe of that motion under the form of ſound; ſo colours in the object are nothing but a diſpoſition to reflect this or that ſort of rays more copiouſly than the reſt: in rays they are nothing but their diſpoſitions to propagate this or that motion into the ſenſorium; and in the ſenſorium they are ſenſations of thoſe motions under the forms of colours. See CHROMATICS.

207 Why the image of the ſun, by heterogeneous rays paſſing through a priſm, is oblong. Plate CCCLXXXIII Fig. 5.

"By the mathematical propoſition above mentioned, it is certain that the rays which are equally refrangible do fall upon a circle anſwering to the ſun's apparent diſk, which will alſo be proved by experiment by and by. Now let AG repreſent the circle which all the moſt refrangible rays, propagated from the whole diſk of the ſun, will illuminate and paint upon the oppoſite wall if they were alone; EL the circle, which all the leaſt refrangible rays would in like manner illuminate if they were alone; BH, CI, DK, the circles which ſo many intermediate ſorts would paint upon the wall, if they were ſingly propagated from the ſun in ſucceſſive order, the reſt being intercepted; and conceive that there are other circles without number, which innumerable other intermediate ſorts of rays would ſucceſſively paint upon the wall, if the ſun ſhould ſucceſſively emit every ſort apart. And ſeeing the ſun emits all theſe ſorts at once, they muſt all together illuminate and paint innumerable equal circles; of all which, being according to their degrees of refrangibility placed in order in a continual ſeries, that oblong ſpectrum PT is compoſed, which was deſcribed in the firſt experiment.

"Now if theſe circles, whilſt their centres keep their diſtances and poſitions, could be made leſs in diameter, their interfering one with another, and conſequently the mixture of the heterogeneous rays, would be proportionably diminiſhed. Let the circles AG, BH, CI, &c. remain as before; and let *a g*, *b h*, *c i*, &c. be ſo many leſs circles lying in a like continual ſeries, between two parallel right lines *a e* and *g l*, with the ſame diſtance between their centres, and illuminated with the ſame ſorts of rays: that is, the circle *ag* with the ſame ſort by which the correſponding circle AG was illuminated; and the reſt of the circles *b h*, *c i*, *d k*, *e l*, reſpectively with the ſame ſorts of rays by which the correſponding circles BH, CI, DK, EL, were illuminated. In the figure PT, compoſed of the great circles, three of thoſe, AG, BH, CI, are ſo expanded into each other, that three ſorts of rays, by which thoſe circles are illuminated, together with innumerable other ſorts of intermediate rays, are mixed at QR in the middle of the circle BH. And the like mixture happens throughout almoſt the whole length of the figure PT. But in the figure *p t*, compoſed of the leſs circles, the three leſs circles *a g*, *b h*, *c i*, which anſwer to thoſe three greater, do not extend into one another; nor are there anywhere mingled ſo much as any two of the three ſorts of rays by which thoſe circles are illuminated, and which in the figure PT are all of them intermingled at QR. So then, if we would diminiſh the mixture of the rays, we are to diminiſh the diameters of the circles. Now theſe would be diminiſhed if the ſun's diameter, to which they anſwer, could be made leſs than it is, or (which comes to the ſame purpoſe) if without doors, at great diſtance from the priſm towards the ſun, ſome opaque body were placed with a round hole in the middle of it to intercept all the ſun's light, except ſo much as coming from the middle of his body could paſs through that hole to the priſm. For ſo the circles AG, BH, and the reſt, would not any longer anſwer to the whole diſk of the ſun, but only to that part of it which could be ſeen from the priſm through that hole; that is, to the apparent magnitude of that hole viewed from the priſm. But that theſe circles may anſwer more diſtinctly to that hole, a lens is to be placed by the priſm to caſt the image of the hole (that is, every one of the circles AG, BH, &c.) diſtinctly upon the paper at PT; after ſuch a manner, as by a lens placed at a window the pictures of objects abroad are caſt diſtinctly upon a paper within the room. If this be done, it will not be neceſſary to place that hole very far off, no not beyond the window. And therefore, inſtead of that hole, I uſed the hole in the window-ſhut as follows.

"In the ſun's light let into my darkened chamber through a ſmall round hole in my window-ſhut, at about 10 or 12 feet from the window, I placed a lens MN, Fig. 6.
by which the image of the hole F might be diſtinctly caſt upon a ſheet of white paper placed at I. Then immediately after the lens I placed a priſm ABC, by which the trajected light might be refracted either upwards or ſidewiſe, and thereby the round image which the lens alone did caſt upon the paper at I, might be drawn out into a long one with parallel ſides, as repreſented at *p t*. This oblong image I let fall upon another at about the ſame diſtance from the priſm as the image at I, moving the paper either towards the priſm or from it, until I found the juſt diſtance where the rectilinear ſides of the images *p t* become moſt diſtinct. For in this caſe the circular images of the hole, which compoſe that image, after the manner that the circles *a g*, *b h*, *c i*, &c. do the figure *p t*, were terminated moſt diſtinctly, and therefore extended into one another the leaſt that they could, and by conſequence the mixture of the heterogeneous rays was now the leaſt of all. The circles *a g*, *b h*, *c i*, &c. which compoſe the image *p t*, are each equal to the circle at I; and therefore, by diminiſhing the hole F, or by removing the lens farther from it, may be diminiſhed at pleaſure, whilſt their centres keep the ſame diſtances from each other. Thus, by diminiſhing the

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the breadth of the image $p\,t$, the circles of heterogeneal rays that compose it may be separated from each other as much as you please. Yet instead of the circular hole F, it is better to substitute an hole shaped like a parallelogram, with its length parallel to the length of the prism. For if this hole be an inch or two long, and but a 10th or 20th part of an inch broad, or narrower, the light of the image $p\,t$ will be as simple as before, or simpler; and the image being much broader, is therefore fitter to have experiments tried in its light than before.

"Homogeneal light is refracted regularly without any dilatation, splitting, or shattering of the rays; and the confused vision of objects seen through refracting bodies by heterogeneous light, arises from the different refrangibility of several sorts of rays. This will appear by the experiments which will follow. In the middle of a black paper I made a round hole about a fifth or a sixth part of an inch in diameter. Upon this part I caused the spectrum of homogeneous light, described in the former article, so to fall that some part of the light might pass through the hole in the paper. This transmitted part of the light, I refracted with a prism placed behind the paper: and letting the refracted light fall perpendicularly upon a white paper, two or three feet distant from the prism, I found that the spectrum formed on the paper by this light was not oblong, as when it is made in the first experiment, by refracting the sun's compound light, but was, so far as I could judge by my eye, perfectly circular, the length being nowhere greater than the breadth; which shows that this light is refracted regularly without any dilatation of the rays, and is an ocular demonstration of the mathematical proposition mentioned above.

208 The image of the sun, by simple and homogeneous light, circular.

"In the homogeneous light I placed a paper circle of a quarter of an inch in diameter: and in the sun's unrefracted, heterogeneous, white light, I placed another paper circle of the same bigness; and going from these papers to the distance of some feet, I viewed both circles through a prism. The circle illuminated by the sun's heterogeneous light appeared very oblong, as in the second experiment, the length being many times greater than the breadth. But the other circle, illuminated with homogeneous light appeared circular, and distinctly defined, as when it is viewed by the naked eye; which proves the whole proposition mentioned in the beginning of this article.

209 Vision more distinct in homogeneous than in heterogeneous light.

"In the homogeneous light I placed flies and such like minute objects, and viewing them through a prism I saw their parts as distinctly defined as if I had viewed them with the naked eye. The same objects placed in the sun's unrefracted heterogeneous light, which was white, I viewed also through a prism, and saw them most confusedly defined, so that I could not distinguish their smaller parts from one another. I placed also the letters of a small print one while in the homogeneous light, and then in the heterogeneous; and viewing them through a prism, they appeared in the latter case so confused and indistinct that I could not read them; but in the former, they appeared so distinct that I could read readily, and thought I saw them as distinct as when I viewed them with my naked eye: in both cases, I viewed the same objects through the same prism, at the same distance from me, and in the same situation. There was no difference but in the lights by which the objects were illuminated, and which in one case was simple, in the other compound; and therefore the distinct vision in the former case, and confused in the latter, could arise from nothing else than from that difference in the lights. Which proves the whole proposition.

"In these three experiments, it is farther very remarkable, that the colour of homogeneous light was never changed by the refraction. And as these colours were not changed by refractions, so neither were they by reflections. For all white, gray, red, yellow, green, blue, violet bodies, as paper, ashes, red lead, orpiment, indigo, bice, gold, silver, copper, grass, blue flowers, violets, bubbles of water tinged with various colours, peacock feathers, the tincture of lignum nephriticum, and such like, in red homogeneous light appeared totally red, in blue light totally blue, in green light totally green, and so of other colours. In the homogeneous light of any colour they all appeared totally of that same colour; with this only difference, that some of them reflected that light more strongly, others more faintly. I never yet found any body which by reflecting homogeneous light could sensibly change its colour.

"From all which it is manifest, that if the sun's light consisted of but one sort of rays, there would be but one colour in the world, nor would it be possible to produce any new colour by reflections and refractions; and by consequence, that the variety of colours depends upon the composition of light.

"The solar image $p\,t$, formed by the separated rays in the 6th experiment, did in the progress from its end p, on which the most refrangible rays fell, unto its end t, on which the least refrangible rays fell, appear tinged with this series of colours; violet, indigo, blue, green, yellow, orange, red, together with all their intermediate degrees in a continual succession perpetually varying; so that there appeared as many degrees of colours as there were sorts of rays differing in refrangibility. And since these colours could not be changed by refractions nor by reflections, it follows, that all homogeneal light has its proper colour answering to its degree of refrangibility.

210 Every homogeneous ray is refracted according to one and the same rule.

"Every homogeneous ray considered apart is refracted, according to one and the same rule; so that its sine of incidence is to its sine of refraction in a given ratio: that is, every different coloured ray has a different ratio belonging to it. This our author has proved by experiment, and by other experiments has determined by what numbers those given ratios are expressed. For instance, if an heterogeneous white ray of the sun emerges out of glass into air; or, which is the same thing, if rays of all colours be supposed to succeed one another in the same line AC, and AD their common sine of incidence in glass be divided into 50 equal parts, then EF and GH, the sines of refraction into air, of the least and most refrangible rays, will be 77 and 78 such parts respectively. And since every colour has several degrees, the sines of refraction of all the degrees of red will have all intermediate degrees of magnitude from 77 to $77\frac{1}{8}$, of all the degrees of orange from $77\frac{1}{8}$ to $77\frac{1}{5}$, of yellow from $77\frac{1}{2}$ to $77\frac{1}{3}$, of green from $77\frac{1}{3}$ to $77\frac{1}{2}$, of blue from $77\frac{1}{2}$ to $77\frac{2}{3}$, of indigo from $77\frac{2}{3}$ to $77\frac{7}{9}$, and of violet from $77\frac{7}{9}$ to 78."

Plate CCLXXXIII. Fig. 15.

Part

Part II. EXPLANATION of OPTICAL PHENOMENA.

Sect. I. *Of the Rainbow.*

THE obfervations of the ancients, and the philofophers of the middle ages, concerning the rainbow, were fuch as could not have efcaped the notice of the moft illiterate hufbandmen; and their various hypothefes deferve no notice. It is a confiderable time, even after the dawn of true philofophy, before we find any difcovery of importance on this fubject. Maurolycus was the firft who pretended to have meafured the diameters of the two rainbows with much exactnefs; and he found that of the inner bow to be 45°, and that of the outer bow 56°; from which Defcartes takes occafion to obferve, how little we can depend upon the obfervations of thofe who were not acquainted with the caufe of the phenomena.

211 Knowledge of the nature of the rainbow a modern difcovery.

Clichtovæus, who died in 1543, had maintained, that the fecond bow is the image of the firft, which he thought was evident from the inverted order of the colours. For, faid he, when we look into the water, all the images that we fee reflected by it are inverted with refpect to the objects themfelves; the tops of the trees, for inftance, that ftand near the brink, appearing lower than the roots.

212 Approach towards it made by Fletcher of Breflaw.

As the rainbow was oppofite to the fun, it was natural to imagine, that its colours were produced by fome kind of reflection of the rays of light from the drops of rain. No perfon feems to have thought of afcribing thefe colours to refraction, till one *Fletcher* of Breflaw, in a treatife publifhed in 1571, endeavoured to account for them by means of a double refraction and one reflection. But he imagined that a ray of light, after entering a drop of rain, and fuffering a refraction both at its entrance and exit, was afterwards reflected from another drop, before it reaches the eye of the fpectator. He feems to have overlooked the reflection at the pofterior furface of the drop, or to have imagined that all the bendings of the light within the drop would not make a fufficient curvature to bring the rays of the fun to the eye of the fpectator. That he fhould think of two refractions, was the neceffary confequence of his fuppofing that the ray entered the drop at all. This fuppofition, therefore, was all that he inftituted to explain the phenomena. B. Porta fuppofed that the rainbow is produced by the refraction of light in the whole body of rain or vapour, but not in the feparate drops.

213 The difcovery made by Antonio de Dominis bifhop of Spalatro.

It is to a man who had no pretenfions to philofophy, that we are indebted for the true explanation. This was Antonio De Dominis, bifhop of Spalatro, whofe treatife *De Radiis Vifus et Lucis*, was publifhed by J. Bartolus in 1611. He firft maintained, that the double refraction of Fletcher, with an intervening reflection, was fufficient to produce the colours of the bow, and alfo to bring the rays that formed them to the eye of the fpectator, without any fubfequent reflection. He diftinctly defcribes the progrefs of a ray of light entering the upper part of the drop, where it fuffers one refraction, and after being thereby thrown upon the back part of the inner furface, is thence reflected to the lower part of the drop; at which place undergoing a fecond refraction, it is thereby bent, fo as to come directly to the eye. To verify this hypothefis, De Dominis proceeded in a very fenfible and philofophical manner. He procured a fmall globe of folid glafs, and viewing it when it was expofed to the rays of the fun, in the fame manner in which he had fuppofed that the drops of rain were fituated with refpect to them, he actually obferved the fame colours which he had feen in the true rainbow, and in the fame order.

Thus the circumftances in which the colours of the rainbow were formed, and the progrefs of a ray of light through a drop of water, were clearly underftood; but philofophers were a long time at a lofs when they endeavoured to affign reafons for all the particular colours, and for the order of them. Indeed nothing but the doctrine of the different refrangibility of the rays of light, could furnifh a complete folution of this difficulty. De Dominis fuppofed that the red rays were thofe which had traverfed the leaft fpace in the infide of a drop of water, and therefore retained more of their native force, and confequently, ftriking the eye more brifkly, gave it a ftronger fenfation; that the green and blue colours were produced by thofe rays, the force of which had been, in fome meafure, obtunded in paffing through a greater body of water; and that all the intermediate colours were compofed (according to the hypothefis which generally prevailed at that time) of a mixture of thefe three primary ones. That the different colours were produced by fome difference in the impulfe of light upon the eye, was an opinion which had been adopted by many perfons, who had ventured to depart from the authority of Ariftotle.

Afterwards the fame De Dominis obferved, that all the rays of the fame colour muft leave the drop of water in a part fimilarly fituated with refpect to the eye, in order that each of the colours may appear in a circle, the centre of which is a point of the heavens, in a line drawn from the fun through the eye of the fpectator. The red rays, he obferved, muft iffue from the drop neareft to the bottom of it, in order that the circle of red may be the outermoft, and the moft elevated in the bow.

Though De Dominis conceived fo juftly the manner in which the inner rainbow is formed, he was far from having as juft an idea of the caufe of the exterior bow. This he endeavoured to explain in the very fame manner as the interior, viz. by one reflection of the light within the drop, preceded and followed by a refraction; fuppofing only that the rays which formed the exterior bow were returned to the eye by a part of the drop lower than that which tranfmitted the red of the interior bow. He alfo fuppofed that the rays which formed one of the bows came from the upper limb of the fun, and thofe which formed the other from the lower limb, without confidering that the bows ought thus to have been contiguous; or rather, that an indefinite number of bows would have had their colours all intermixed.

When Sir Ifaac Newton difcovered the different refrangibility of the rays of light, he immediately applied the difcovery to the phenomena of the rainbow, taking up

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up the ſubject where De Dominis and Deſcartes were obliged to leave their inveſtigations imperfect.

214 The true cauſe of the colours of the rainbow. Plate CCCLXXXIII. Fig. 8.

Let a be a drop of water, and S a pencil of light; which, on its leaving the drop reaches the eye of the ſpectator. This ray, at its entrance into the drop, begins to be decompoſed into its proper colours; and upon leaving the drop, after one reflection and a ſecond refraction, it is farther decompoſed into as many ſmall differently-coloured pencils as there are primitive colours in the light. Three of them only are drawn in this figure, of which the blue is the moſt, and the red the leaſt, refracted.

The theory of the different refrangibility of light enables us to aſſign a reaſon for the ſize of a bow of each particular colour. Newton, having found that the ſines of refraction of the moſt refrangible and leaſt refrangible rays, in paſſing from rain water into air, are in the ratio of 185 to 182, when the ſine of incidence is 138, computed the ſize of the bow; and found, that if the ſun was only a phyſical point, the breadth of the inner bow would be 2°; and if to this $30'$ were added for the apparent diameter of the ſun, the whole breadth would be $2\frac{1}{2}^{\circ}$. But as the outermoſt colours, eſpecially the violet, are extremely faint, the breadth of the bow will not appear to exceed two degrees. He found, by the ſame principles, that the breadth of the exterior bow, if it was everywhere equally vivid, would be $4^{\circ}\ 20'$. But in this caſe there is a greater deduction to be made, on account of the faintneſs of the light of the exterior bow; ſo that it will not appear to be more than 3 degrees broad.

The principal phenomena of the rainbow are explained on Sir Iſaac Newton's principles in the following propoſitions.

Prop. I.

When the rays of the ſun fall upon a drop of rain and enter into it, ſome of them, after one reflection and two refractions, may come to the eye of a ſpectator who has his back towards the ſun, and his face towards the drop.

215 Explanation of the phenomena of the rainbow on the principles of Newton. Fig. 9.

If XY be a drop of rain, and if the ſun ſhine upon it in any lines sf, sd, sa, &c. moſt of the rays will enter into the drop; ſome of them only will be reflected from the firſt ſurface; thoſe rays which are thence reflected do not come under our preſent conſideration, becauſe they are never refracted at all. The greateſt part of the rays then enter the drop, and thoſe paſſing on to the ſecond ſurface, will moſt of them be tranſmitted through the drop. At the ſecond ſurface, or hinder part of the drop, at pg, ſome few rays will be reflected, whilſt the reſt are tranſmitted; thoſe rays proceed in ſome ſuch lines as nr, nq: and coming out of the drop in the lines rv, qt, may fall upon the eye of the ſpectator, who is placed anywhere in thoſe lines, with his face towards the drop, and conſequently with his back towards the ſun, which is ſuppoſed to ſhine upon the drop in the lines sf, sd, sa, &c. Theſe rays are twice refracted and once reflected; they are refracted when they paſs out of the air into the drop; they are reflected from the ſecond ſurface, and are refracted again when they paſs out of the drop into the air.

Def. When rays of light reflected from a drop of rain come to the eye, thoſe are called *effectual* which are able to excite a ſenſation.

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Prop. II.

When rays of light come out of a drop of rain, they will not be effectual, unleſs they are parallel and contiguous.

There are but few rays that can come to the eye at all: for ſince the greateſt part of thoſe rays which enter the drop XY between X and a, paſs out of the drop through the hinder ſurface pg; only few are thence reflected, and come out through the nearer ſurface between a and Y. Now, ſuch rays as emerge, or come out of the drop, between a and Y, will be ineffectual, unleſs they are parallel to one another, as rv and qt are; becauſe ſuch rays as come out diverging from one another will be ſo far aſunder when they come to the eye, that all of them cannot enter the pupil; and the very few that can enter it will not be ſufficient to excite any ſenſation. But even rays, which are parallel, as rv, qt, will not be effectual, unleſs there are ſeveral of them contiguous or very near to one another. The two rays rv and qt alone will not be perceived, though both of them enter the eye; for ſo very few rays are not ſufficient to excite a ſenſation. Fig. 9.

Prop. III.

When rays of light come out of a drop of rain after one reflection, thoſe will be effectual which are reflected from the ſame point, and which entered the drop near to one another.

Any rays, as sb and cd, when they have paſſed out of the air into a drop of water, will be refracted towards the perpendiculars bl, dl; and as the ray sb falls farther from the axis av than the ray cd, sb will be more refracted than cd; ſo that theſe rays, though parallel to one another at their incidence, may deſcribe the lines be and de after refraction, and be reflected from the ſame point e. Now all rays, which are thus reflected from the ſame point, when they have deſcribed the lines ef, eg, and after reflection emerge at f and g, will be ſo refracted, when they paſs out of the drop into the air, as to deſcribe the parallel lines fh, gi. If theſe rays were to return from e in the lines eb, ed, and were to emerge at b and d, they would be refracted into the lines of their incidence bs, dc. But if theſe rays, inſtead of being returned in the lines eb, ed, are reflected from the ſame point e in the lines eg, ef, the lines of reflection eg and ef will be inclined to one another and to the ſurface of the drop, juſt as much as the lines eb and ed are. Firſt, eb and eg make the ſame angle with the ſurface of the drop: for the angle bex, which eb makes with the ſurface of the drop, is the complement of incidence, and the angle gev, which eg makes with the ſurface, is the complement of reflection; and theſe two are equal to one another. In the ſame manner it might be ſhown, that ed and cf make equal angles with the ſurface of the drop. Secondly, The angle $bcd = feg$; or the reflected rays eg, ef, and the incident rays be, de, are equally inclined to each other. For the angle of incidence $bel = gel$, the angle of reflection, and the angle of incidence $del = fel$, the angle

Plate CCCLXXXIII. Fig. 10.

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angle of reflection: consequently, the difference between the angles of incidence is equal to the difference between the angles of reflection, or $bel-del=gel-fel$, or $bed=gef$. Since therefore either the lines eg, ef, or the lines eb, ed, are equally inclined both to one another and to the surface of the drop; the rays will be refracted in the same manner, whether they return in the lines eb, ed, or are reflected in the lines eg, ef. But if they return in the lines eb, ed, the refraction, when they emerge at b and d, would make them parallel. Therefore, if they are reflected from one and the same point e in the lines eg, ef, the refraction, when they emerge at g and f, will likewise make them parallel.

But though such rays as are reflected from the same point in the hinder part of a drop of rain, are parallel to one another when they emerge, and so have one condition that is requisite towards making them effectual, yet there is another condition necessary; for rays that are effectual, must be contiguous as well as parallel. And though rays, which enter the drop in different places, may be parallel when they emerge, those only will be contiguous which enter it nearly at the same place.

Fig. 9. Let XY be a drop of rain, ag the axis or diameter of the drop, and sa a ray of light that enters the drop at a. This ray sa, being perpendicular to both the surfaces, will pass through the drop in the line agh without being refracted; but any collateral rays, such as those that fall about sb, will be made to converge to the axis, and passing out at n will meet the axis at h: Rays which fall farther from the axis than sb, such as those which fall about sc, will likewise be made to converge; but their focus will be nearer to the drop than h. Suppose therefore i to be the focus of the rays that fall about sc, any ray sc, when it has described the line co within the drop, and is tending to the focus i, will pass out of the drop at the point o. The rays that fall upon the drop about sd, will converge to a focus still nearer than i, as at k. These rays therefore go out of the drop at p. The rays, that fall about se, will converge to a focus nearer than k, as suppose at l; and the ray se, when it has described the line eo within the drop, and is tending to l, will pass out at the point o. The rays that fall still more remote from the axis will converge to a focus still nearer. Thus the ray sf will after refraction converge to a focus at m, which is nearer than l; and having described the line fn within the drop, it will pass out to the point n. Now we may here observe, that as any rays sb or sc, fall farther above the axis sa, the points n, or o, where they pass out behind the drop, will be farther above g; or that, as the incident ray rises from the axis sa, the arc gno increases, till we come to some ray sd, which passes out of the drop at p; and this is the highest point where any ray that falls upon the quadrant or quarter ax can pass out: for any rays se, or sf, that fall higher than sd, will not pass out on any point above p, but at the points o, or n, which are below it. Consequently, though the arc $gnop$ increases, whilst the distance of the incident ray from the axis sa increases, till we come to the ray sd; yet afterwards, the higher the ray falls above the axis sa, this arc $pong$ will decrease.

We have hitherto spoken of the points on the posterior part of the drop, where the rays pass out of it; but this was for the sake of determining the points from which those rays are reflected, which do not pass out behind the drop. For, in explaining the rainbow, we have no further reason to consider those rays which go through the drop; since they can never come to the eye of a spectator placed anywhere in the lines rv or qt with his face towards the drop. Now, as there are many rays which pass out of the drop between g and p, so some rays will be thence reflected: and consequently the several points between g and p, which are the points where some of the rays pass out of the drop, are likewise the points of reflection for the rest which do not pass out. Therefore in respect of those rays which are reflected we may call gp the arc of reflection; and may say, that this arc of reflection increases, as the distance of the incident ray from the axis sa increases, till we come to the ray sd; the arc of reflection is gn for the ray sb, it is go for the ray sc, and gp for the ray sd. But after this, as the distance of the incident ray from the axis sa increases, the arc of reflection decreases; for og less than pg is the arc of reflection for the ray se, and ng is the arc of reflection for the ray sf.

Hence it is obvious, that some ray, which falls above sd, may be reflected from the same point with some other ray which falls below sd. Thus, for instance, the ray sb will be reflected from the point n, and the rays sf will be reflected from the same point; and consequently, when the reflected rays nr, nq, are refracted as they pass out of the drop at r and q, they will be parallel. But since the intermediate rays, which enter the drop between sf and sb, are not reflected from the same point n, these two rays alone will be parallel to one another when they come out of the drop, and the intermediate rays will not be parallel to them. And consequently these rays rv, qt, though they are parallel after they emerge at r and q, will not be contiguous, and for that reason will not be effectual; the ray sd is reflected from p, which has been shown to be the limit of the arc of reflection; such rays as fall just above sd, and just below sd, will be reflected from nearly the same point p, as appears from what has been already shown. These rays therefore will be parallel, because they are reflected from the same point p; and they will likewise be contiguous, because they all of them enter the drop at the same place very near to d. Consequently, such rays as enter the drop at d, and are reflected from p the limit of the arc of reflection, will be effectual; since, when they emerge at the part of the drop between a and y, they will be both parallel and contiguous.

If it can be shown that the rainbow is produced by the rays of the sun which are thus reflected from drops of rain as they fall while the sun shines upon them, this proposition may serve to show us, that this appearance is not produced by *any* rays that fall upon *any part*, and are reflected from any part of those drops: since this appearance cannot be produced by any rays but those which are effectual; and effectual rays must always enter each drop at one certain place in the anterior part of it, and must likewise be reflected from one certain place in the posterior surface.

Prop. IV.

When rays that are effectual emerge from a drop of rain after one reflection and two refractions, those which are most refrangible will, at

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at their emerſion, make a leſs angle with the incident rays than thoſe which are leaſt refrangible; and by this means the rays of different colours will be ſeparated from one another.

Plate CCCLXXXIII. Fig. 10. Let fh and gi be effectual violet rays emerging from the drop at fg; and fn, gp, effectual red rays emerging from the ſame drop at the ſame place. Now, though all the violet rays are parallel to one another, becauſe they are ſuppoſed effectual, and though all the red rays are likewiſe parallel to one another for the ſame reaſon; yet the violet rays will not be parallel to the red rays. Theſe rays, as they have different degrees of refrangibility, will diverge from one another; any violet ray gi, which emerges at g, will diverge from any red ray gp, which emerges at the ſame place. Now, both the violet ray gi, and the red ray gp, as they paſs out of the drop of water into the air, will be refracted from the perpendicular lo. But the violet ray is more refrangible than the red one; and for that reaſon gi, or the refracted violet ray, will make a greater angle with the perpendicular than gp the refracted red ray; or the angle igo will be greater than the angle pgo. Suppoſe the incident ray sb to be continued in the direction sk, and the violet ray ig to be continued backward in the direction ik, till it meets the incident ray at k. Suppoſe likewiſe the red ray pg to be continued backwards in the ſame manner, till it meets the incident ray at w. The angle iks is that which the violet ray, or moſt refrangible ray at its emerſion, makes with the incident ray; and the angle pws is that which the red ray, or leaſt refrangible ray at its emerſion, makes with the incident ray. The angle iks is leſs than the angle pws. For, in the triangle, gwk, gws, or pws, is the external angle at the baſe, and gkw or iks is one of the internal oppoſite angles. (Euc. B. I. Prop. xvi.) What has been ſhown to be true of the rays gi and gp might be ſhown in the ſame manner of the rays fh and fn, or of any other rays that emerge reſpectively parallel to gi and gp. But all the effectual violet rays are parallel to gi, and all the effectual red rays are parallel to gp. Therefore the effectual violet rays at their emerſion make a leſs angle with the incident ones than the effectual red ones. For the ſame reaſon, in all the other ſorts of rays, thoſe which are moſt refrangible, at their emerſion from a drop of rain after one reflection, will make a leſs angle with the incident rays, than thoſe which are leſs refrangible.

Otherwiſe: When the rays gi and gp emerge at the ſame point g, as they both come out of water into air, and conſequently are refracted from the perpendicular, inſtead of going ſtraight forwards in the line eg continued, they will both be turned round upon the point g from the perpendicular go. Now it is eaſy to conceive, that either of theſe lines might be turned in this manner upon the point g as upon a centre, till they became parallel to sb the incident ray. But if either of theſe lines or rays were refracted ſo much from go as to become parallel to sb, the ray thus refracted, would, after emerſion, make no angle with sk, becauſe it would be parallel to it. Conſequently that ray which is moſt turned round upon the point g, or that ray which is moſt refrangible, will after emerſion be neareſt parallel to the incident ray, or will make the leaſt angle with it. The ſame may be proved of all other rays emerging parallel to gi and gp reſpectively, or of all effectual rays; thoſe which are moſt refrangible will after emerſion make a leſs angle with the incident rays, than thoſe do which are leaſt refrangible.

But ſince the effectual rays of different colours make different angles with sk at their emerſion, they will be ſeparated from one another: ſo that if the eye were placed in the beam $fghi$, it would receive only rays of one colour from the drop $xagv$; and if it were placed in the beam $fgnp$, it would receive only rays of ſome other colour.

The angle swp, which the leaſt refrangible or red rays make with the incident ones when they emerge ſo as to be effectual, is found by calculation to be $42^\circ\ 2'$. And the angle ski, which the moſt refrangible rays make with the incident ones when they emerge ſo as to be effectual, is found to be $40^\circ\ 17'$. The rays which have the intermediate degrees of refrangibility, make with the incident ones intermediate angles between $42^\circ\ 2'$, and $40^\circ\ 17'$.

Prop. V.

If a line is ſuppoſed to be drawn from the centre of the ſun through the eye of the ſpectator, the angle which any effectual ray, after two refractions and one reflection, makes with the incident ray, will be equal to the angle which it makes with that line.

Let the eye of the ſpectator be at i, and let qt be the line ſuppoſed to be drawn from the centre of the ſun through the eye of the ſpectator; the angle git, which any effectual ray makes with this line, will be equal to the angle iks, which the ſame ray makes with the incident ray sb or sk. If sb is a ray coming from the centre of the ſun, then ſince qt is ſuppoſed to be drawn from the ſame point, theſe two lines, upon account of the remoteneſs of the point from whence they are drawn, may be looked upon as parallel to one another. But the right line ki croſſing theſe two parallel lines will make the alternate angles equal. (Euc. B. I. Prop. xxix.) Therefore kit or $git = ski$. Plate CCCLXXXIII. Fig. 10.

Prop. VI.

When the ſun ſhines upon the drops of rain as they are falling, the rays that come from thoſe drops to the eye of a ſpectator, after one reflection and two refractions, produce the primary rainbow.

216 Two rain-bows ſeen at once. Fig. 11.

If the ſun ſhines upon the rain as it falls, there are commonly ſeen two bows, as AFB, CHD; or if the cloud and rain does not reach over that whole ſide of the ſky where the bows appear, then only a part of one or of both bows is ſeen in that place where the rain falls. Of theſe two bows, the innermoſt AFB is the more vivid of the two, and this is called the *primary bow*. The outer part TFY of the primary bow is red, the inner part VEX is violet; the intermediate parts, reckoning from the red to the violet, are orange, yellow, green, blue, and indigo. Suppoſe the ſpectator's eye to be at O, and let LOP be an imaginary line drawn

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drawn from the centre of the ſun through the eye of the ſpectator: if a beam of light S coming from the ſun fall upon any drop F; and the rays that emerge at F in the line FO, ſo as to be effectual, make an angle FOP of 42° 2′ with the line LP; then theſe effectual rays make an angle of 42° 2′ with the incident rays, by the preceding propoſition, and conſequently theſe rays will be red, ſo that the drop F will appear red. All the other rays, which emerge at F, and would be effectual if they fell upon the eye, are refracted more than the red ones, and conſequently will paſs above the eye. If a beam of light S fall upon the drop E, and the rays that emerge at E in the line EO, ſo as to be effectual, make an angle of 40° 17′ with the line LP; then theſe effectual rays make likewiſe an angle of 40° 17′ with the incident rays, and the drop E will appear of a violet colour. All the other rays, which emerge at E, and would be effectual if they came to the eye, are refracted leſs than the violet ones, and therefore paſs below the eye. The intermediate drops between F and E will for the ſame reaſons be of the intermediate colours.

Thus we have ſhown why a ſet of drops from F to E, as they are falling, ſhould appear of the ſeven primary colours. It is not neceſſary that the ſeveral drops, which produce theſe colours, ſhould all of them fall at exactly the ſame diſtance from the eye. The angle FOP, for example, is the ſame whether the diſtance of the drop from the eye is OF, or whether it is in any other part of the line OF ſomething nearer to the eye. And whilſt the angle FOP is the ſame, the angle made by the emerging and incident rays, and conſequently the colour of the drop, will be the ſame. This is equally true of any other drop. So that though in the figure the drops F and E are repreſented as falling perpendicularly one under the other, yet this is not neceſſary in order to produce the bow.

But the coloured line FE, which we have already accounted for, is only the breadth of the bow. It ſtill remains to be ſhewn, why not only the drop F ſhould appear red, but why all the other drops from A to B in the arc ATFYB ſhould appear of the ſame colour. Now it is evident, that wherever a drop of rain is placed, if the angle which the effectual rays make with the line LP is equal to the angle FOP, that is, if the angle which the effectual rays make with the incident rays is 42° 2′, any of thoſe drops will be red, for the ſame reaſon that the drop F is of this colour.

If FOP were to turn round upon the line OP, ſo that one end of this line ſhould always be at the eye, and the other be at P oppoſite to the ſun; ſuch a motion of this figure would be like that of a pair of compaſſes turning round upon one of the legs OP with the opening FOP. In this revolution the drop F would deſcribe a circle, P would be the centre, and ATFYB would be an arc in this circle. Now ſince, in this motion of the line and drop OF, the angle made by FO with OP, that is the angle FOP, continues the ſame; if the ſun were to ſhine upon this drop as it revolves, the effectual rays would make the ſame angle with the incident rays, in whatever part of the arc ATFYB the drop was to be. Therefore, whether the drop be at A, or at T, or at Y, or at B, or wherever elſe it is in this whole arc, it would appear red, as it does at F.—The drops of rain, as they fall, are not indeed turned round in this manner: but then, as great numbers of them are falling at once in right lines from the cloud, whilſt one drop is at F, there will be others at Y, at T, at B, at A, and in every other part of the arc ATFYB: and all theſe drops will be red for the ſame reaſon that the drop F would have been red, if it had been in the ſame place. Therefore, when the ſun ſhines upon the rain as it falls, there will be a red arc ATFYB oppoſite to the ſun. In the ſame manner, becauſe the drop E is violet, we might prove that any other drop, which, whilſt it is falling, is in any part of the arc AVEXB, will be violet; and conſequently, at the ſame time that the red arc ATFYB appears, there will likewiſe be a violet arc AVEXB below or within it. FE is the diſtance between theſe two coloured arcs; and from what has been ſaid, it follows, that the intermediate ſpace between theſe two arcs will be filled up with arcs of the intermediate colours, orange, yellow, blue, green, and indigo. All theſe coloured arcs together make up the primary rainbow.

Prop. VII.

The primary rainbow is never a greater arc than a ſemicircle.

Plate CCCLXXXIII. Fig. 9.

217 Why the arc of the primary rainbow is never greater than a ſemicircle.

Since the line LOP is drawn from the ſun through the eye of the ſpectator, and ſince P is the centre of the rainbow; it follows, that the centre of the rainbow is always oppoſite to the ſun. The angle FOP is an angle of 42° 2′, as was obſerved, or F the higheſt part of the bow is 42° 2′ from P the centre of it. If the ſun is more than 42° 2′ high, P the centre of the rainbow, which is oppoſite to the ſun, will be more than 42° 2′ below the horizon; and conſequently F the top of the bow, which is only 42° 2′ from P, will be below the horizon; that is, when the ſun is more than 42° 2′ high, no primary rainbow will be ſeen. If the altitude of the ſun be ſomething leſs than 42° 2′, then P will be ſomething leſs than 42° 2′ below the horizon; and conſequently F, which is only 42° 2′ from P, will be juſt above the horizon; that is, a ſmall part of the bow at this height of the ſun will appear cloſe to the ground oppoſite to the ſun. If the ſun be 20° high, then P will be 20° below the horizon; and F the top of the bow, being 42° 2′ from P, will be 22° 2′ above the horizon; therefore, at this height of the ſun, the bow will be an arc of a circle whoſe centre is below the horizon; and conſequently that arc of the circle which is above the horizon, or the bow, will be leſs than a ſemicircle. If the ſun be in the horizon, then P, the centre of the bow, will be in the oppoſite part of the horizon; F, the top of the bow, will be 42° 2′ above the horizon; and the bow itſelf, becauſe the horizon paſſes through the centre of it, will be a ſemicircle. More than a ſemicircle can never appear; becauſe if the bow were more than a ſemicircle, P the centre of it muſt be above the horizon; but P is always oppoſite to the ſun, therefore P cannot be above the horizon, unleſs the ſun is below it; and when the ſun is ſet, or is below the horizon, it cannot ſhine upon the drops of rain as they fall; and conſequently, when the ſun is below the horizon, no bow at all can be ſeen.

Prop. VIII.

When the rays of the ſun fall upon a drop of rain, ſome of them, after two reflections and two re-

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fractions, may come to the eye of a spectator, who has his back towards the sun and his face towards the drop.

Fig. 12.

If HGW is a drop of rain, and parallel rays coming from the sun, as *z v*, *y w*, fall upon the lower part of it, they will be refracted towards the perpendiculars *v l*, *w l*, as they enter into it, and will describe some such lines as *v h*, *w i*. At *h* and *i* great part of these rays will pass out of the drop; but some of them will be reflected from thence in the lines *h f*, *i g*. At *f* and *g* again, great part of the rays that were reflected thither will pass out of the drop. But these rays will not come to the eye of a spectator at *o*. Here, however, all the rays will not pass out; but some will be reflected from *f* and *g*, in some such lines as *f d*, *g h*; and these, when they emerge out of the drop of water into the air at *b* and *d*, will be refracted from the perpendiculars, and, describing the lines *d t*, *b o*, may come to the eye of the spectator who has his back towards the sun and his face towards the drop.

Prop. IX.

Those rays, which are parallel to one another after they have been once refracted and once reflected in a drop of rain, will be effectual when they emerge after two refractions and two reflections.

No rays can be effectual, unless they are contiguous and parallel. It appears from what was said, that when rays come out of a drop of rain contiguous to one another, either after one or after two reflections, they must enter the drop nearly at the same place. And if such rays as are contiguous are also parallel after the first reflection, they will emerge parallel, and therefore will be effectual. Let *z v* and *y w* be contiguous rays which come from the sun, and are parallel when they fall upon the lower part of the drop, suppose these rays to be refracted at *v* and *w*, and to be reflected at *h* and *i*; if they are parallel, as *h f*, *g i*, after this first reflection, then, after they are reflected a second time from *f* and *g*, and refracted a second time as they emerge at *d* and *b*, they will go out of the drop in the parallel lines *d t* and *b o*, and will therefore be effectual.

The rays *z v*, *y w*, are refracted towards the perpendiculars *v l*, *w l*, when they enter the drop, and will be made to converge. As these rays are very oblique, their focus will not be far from the surface *v w*. If this focus be at *k*, the rays, after they have passed the focus, will diverge from thence in the directions *k h*, *k i*; and if *k i* is the principal focal distance of the concave reflecting surface *h i*, the reflected rays *h f*, *i g*, will be parallel. These rays *e f*, *i g*, are reflected again from the concave surface *f g*, and will meet in a focus at *e*, so that *g e* will be the principal focal distance of this reflecting surface *f g*. And because *h i* and *f g* are parts of the same sphere, the principal focal distances *g e* and *k i* will be equal. When the rays have passed the focus *e*, they will thence diverge in the line *e d*, *e b*: and we are to show, that when they emerge at *d* and *b*, and are refracted there, they will become parallel.

Now if the rays *v k*, *w k*, when they have met at *k*, were to be turned back again in the directions *k v*, *k w*, and were to emerge at *v* and *w*, they would be refracted into the lines of their incidence, *v z*, *w y*, and therefore would be parallel. But since *g e* = *i k*, as has already been shown, the rays *e d*, *e b*, that diverge from *e*, fall in the same manner upon the drop at *d* and *b*, as the rays *k v*, *k w*, would fall upon it at *v* and *w*; and *e d*, *e b*, are just as much inclined to the refracting surface *d b*, as *k v*, *k w* would be to the surface *v w*. Hence it follows, that the rays *e d*, *e b*, emerging at *d* and *b*, will be refracted in the same manner, and will have the same direction in respect of one another, as *k v*, *k w* would have. But *k v* and *k w* would be parallel after refraction. Therefore the rays *e d* and *e b* will emerge in the lines *d p*, *b o*, parallel to one another, and consequently effectual.

Prop. X.

When rays that are effectual emerge from a drop of rain after two reflections and two refractions, those which are most refrangible will at their emersion make a greater angle with the incident rays than those do which are least refrangible; and by this means the rays of different colours will be separated from one another.

If rays of different colours, which are differently refrangible, emerge at any point *b*, these rays will not be all of them equally refracted from the perpendicular. Thus, if *b o* is a red ray, which is of all others the least refrangible, and *b m* is a violet ray, which is of all others the most refrangible; when these two rays emerge at *b*, the violet ray will be refracted more from the perpendicular *b x* than the red ray, and the refracted angle *x b m* will be greater than the refracted angle *x b o*. Hence it follows, that these two rays, after emersion, will diverge from one another. In like manner, the rays that emerge at *d* will diverge from one another; a red ray will emerge in the line *d p*, a violet ray in the line *d t*. So that though all the effectual red rays of the beam *b d m t* are parallel to one another, and all the effectual red rays of the beam *b d o p* are likewise parallel, yet the violet rays will not be parallel to the red beam. Thus the rays of different colours will be separated from one another.

Plate CCCLXXXIII. Fig 12.

This will appear farther, if we consider what the proposition affirms, That any violet or most refrangible ray will make a greater angle with the incident rays, than any red or least refrangible ray makes with the same incident rays. Thus if *y w* be an incident ray, *b m* a violet ray emerging from the point *b*, and *b o* a red ray emerging from the same point; the angle which the violet ray makes with the incident one is *y r m*, and that which the red ray makes with it is *y s o*. Now *y r m* is greater than *y s o*. For in the triangle *b r s* the internal angle *b r s* is less than *b s y* the external angle at the base. (Eucl. B. I. Prop. xvi.) But *y r m* is the complement of *b r s* or of *b r y* to two right ones, and *y s o* is the complement of *b s y* to two right ones. Therefore, since *b r y* is less than *b s y*, the complement of *b r y* to two right angles will be greater than the complement of *b s y* to two right angles; or *y r m* will be greater than *y s o*.

Otherwise: Both the rays *b o* and *b m*, when they are refracted in passing out of the drop at *b*, are turned round upon the point *b* from the perpendicular *b x*. Now either of these lines *b o* or *b m* might be turned round

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round in this manner, till it made a right angle with yw. Consequently, that ray which is most turned round upon b, or which is most refracted, will make an angle with yw, that will be nearer to a right one than that ray makes with it which is least turned round upon b, or which is least refracted. Therefore that ray which is most refracted will make a greater angle with the incident ray than that which is least refracted.

But since the emerging rays, being differently refrangible, make different angles with the same incident ray yw, the refraction which they suffer at emersion will separate them from one another.

The angle yrm, which the most refrangible or violet rays make with the incident ones, is found by calculation to be $54^\circ\ 7'$; and the angle yso, which the least refrangible or red rays make with the incident ones, is found to be $50^\circ\ 57'$: the angles, which the rays of the intermediate colours, indigo, blue, green, yellow, and orange, make with the incident rays, are intermediate angles between $54^\circ\ 7'$ and $50^\circ\ 57'$.

Prop. XI.

If a line is supposed to be drawn from the centre of the sun through the eye of the spectator; the angle which, after two refractions and two reflections, any effectual ray makes with the incident ray, will be equal to the angle which it makes with that line.

Fig. 12. If yw is an incident ray, bo an effectual ray, and qn a line drawn from the centre of the sun though o the eye of the spectator; the angle yso, which the effectual ray makes with the incident ray, is equal to son the angle which the same effectual ray makes with the line qn. For yw and qn, considered as drawn from the centre of the sun, are parallel; bo crosses them, and consequently makes the alternate angles yso, son, equal to one another. Eucl. B. I. Prop. xxix.

Prop. XII.

When the sun shines upon the drops of rain as they are falling, the rays, that come from these drops to the eye of a spectator, after two reflections and two refractions, produce the secondary rainbow.

218 The secondary rainbow produced by two reflections and two refractions.

Fig. 11.

The secondary rainbow is the outermost, CHD. When the sun shines upon a drop of rain H; and the rays HO, which emerge at H so as to be effectual, make an angle HOP of $54^\circ\ 7'$ with LOP a line drawn from the sun through the eye of the spectator; the same effectual rays will make likewise an angle of $54^\circ\ 7'$ with the incident rays S, and the rays which emerge at this angle are violet ones, by what was observed above. Therefore, if the spectator's eye is at O, none but violet rays will enter it: for as all the other rays make a less angle with OP, they will fall above the spectator's eye. In like manner, if the effectual rays that emerge from the drop G make an angle of $50^\circ\ 57'$ with the line OP, they will likewise make the same angle with the incident rays S; and consequently, from the drop G no rays will come to the spectator's eye at O but red ones; for all the other rays making a greater angle with the line OP, will fall below the eye at O. For the same reason, the rays emerging from the intermediate drops between H and G, and coming to the spectator's eye at O, will emerge at intermediate angles, and therefore will have the intermediate colours. Thus if there are seven drops from H to G inclusively, their colours will be violet, indigo, blue, green, yellow, orange, and red. This coloured line is the breadth of the secondary rainbow.

Now, if HOP were to turn round upon the line OP, like a pair of compasses upon one of the legs OP with the opening HOP, it is plain from the supposition, that, in such a revolution of the drop H, the angle HOP would be the same, and consequently the emerging rays would make the same angle with the incident ones. But in such a revolution the drop would describe a circle of which P would be the centre, and CNHRD an arc. Consequently, since, when the drop is at N, or at R, or anywhere else in that arc, the emerging rays make the same angle with the incident ones as when the drop is at H, the colour of the drop will be the same to an eye placed at O, whether the drop is at N, or at H, or at R, or anywhere else in that arc. Now, though the drop does not thus turn round as it falls, and does not pass through the several parts of this arc, yet, since there are drops of rain falling everywhere at the same time, when one drop is at H, there will be another at R, another at N, and others in all parts of the arc; and these drops will all be violet-coloured, for the same reason that the drop H would have been of this colour if it had been in any of those places. In like manner, as the drop G is red when it is at G, it would likewise be red in any part of the arc CWGQD; and so will any other drop when, as it is falling, it comes to any part of that arc. Thus as the sun shines upon the rain, whilst it falls, there will be two arcs produced, a violet-coloured arc CNHRD, and a red one CWGQD; and for the same reasons the intermediate space between these two arcs will be filled up with arcs of the intermediate colours. All these arcs together make up the secondary rainbow.

Prop. XIII.

The colours of the secondary rainbow are fainter than those of the primary rainbow; and are arranged in the contrary order.

219 Why the colours of the secondary rainbow are fainter than those of the primary, and arranged in a contrary order.

The primary rainbow is produced by such rays as have been only once reflected; the secondary rainbow is produced by such rays as have been twice reflected. But at every reflection some rays pass out of the drop of rain without being reflected; so that the oftener the rays are reflected, the fewer of them are left. Therefore the colours of the secondary bow are produced by fewer rays, and consequently will be fainter, than the colours of the primary bow.

In the primary bow, reckoning from the outside of it, the colours are arranged in this order; red, orange, yellow, green, blue, indigo, violet. In the secondary bow, reckoning from the outside, the colours are violet, indigo, blue, green, yellow, orange, red. So that the the red, which is the outermost or highest colour in the primary bow, is the innermost or lowest colour in the secondary one.

Now the violet rays, when they emerge so as to be effectual

Concavity of the Sky. Plate CCCLXXXIII. Fig. 11. effectual after one reflection, make a less angle with the incident rays than the red ones; consequently the violet rays make a less angle with the lines OP than the red ones. But, in the primary rainbow, the rays are only once reflected, and the angle which the effectual rays make with OP is the distance of the coloured drop from P the centre of the bow. Therefore the violet drops, or violet arc, in the primary bow, will be nearer to the centre of the bow than the red drops or red arc; that is, the innermost colour in the primary bow will be violet, and the outermost colour will be red. And, for the same reason, through the whole primary bow, every colour will be nearer the centre P, as the rays of that colour are more refrangible.

But the violet rays, when they emerge so as to be effectual after two reflections, make a greater angle with the incident rays than the red ones; consequently the violet rays will make a greater angle with the line OP, than the red ones. But in the secondary rainbow the rays are twice reflected, and the angle which the effectual rays make with OP is the distance of the coloured drop from P the centre of the bow. Therefore the violet drops or violet arc in the secondary bow will be farther from the centre of the bow, than the red drops or red arc; that is, the outermost colour in the secondary bow will be violet, and the innermost colour will be red. And, for the same reason, through the whole secondary bow, every colour will be farther from the centre P, as the rays of that colour are more refrangible.

Sect. II. *Of Coronas, Parhelia, &c.*

Under the articles Corona and Parhelion, a pretty full account is given of the different hypotheses concerning these phenomena, and likewise of the method by which these hypotheses are supported, from the known laws of refraction and reflection. To these articles therefore, in order to avoid repetition, we must refer.

Sect. III. *Of the Concave Figure of the Sky.*

220 Extent of the visible horizon on a plane surface. The apparent concavity of the sky is only an optical deception founded on the incapacity of our organs of vision to take in very large distances. Dr Smith, has demonstrated, that, if the surface of the earth were perfectly plane, the distance of the visible horizon from the eye would scarcely exceed the distance of 5000 times the height of the eye above the ground: beyond this distance, all objects would appear in the visible horizon. For, let OP be the height of the eye above the line PA drawn upon the ground; and if an object AB = PO, be removed to a distance PA equal to 5000 times that height, it will hardly be visible by reason of the smallness of the angle AOB. Consequently any distance AC, however great, beyond A, will be invisible. For since AC and BO are parallel, the ray CO will always cut AB in some point D between A and B; and therefore the angle AOC, or AOD, will always be less than AOB, and therefore AD or AC will be invisible. Consequently all objects and clouds, as CE and FG, placed at all distances beyond A, if they be high enough to be visible, or to subtend a bigger angle at the eye than AOB, will appear at the horizon AB; because the distance AC is invisible.

Plate CCCLXXXIV. Fig. 8.

221 Why a long row of objects appears circular. Fig. 9. Hence, if we suppose a long row of objects, or a long wall ABZY, built upon this plane, and its perpendicular distance OA from the eye at O to be equal to or greater than the distance O a of the visible horizon, it will not appear straight, but circular, as if it were built upon the circumference of the horizon $acegy$: and if the wall be continued to an immense distance, its extreme parts YZ will appear in the horizon at yz, where it is cut by a line Oy parallel to the wall. For, supposing a ray YO, the angle YOy will become insensibly small. Imagine this infinite plane OAYy, with the wall upon it, to be turned about the horizontal line O like the lid of a box, till it becomes perpendicular to the other half of the horizontal plane LMy, and the wall parallel to it, like a vast ceiling overhead; and then the wall will appear like the concave figure of the clouds overhead. But though the wall in the horizon appear in the figure of a semicircle, yet the ceiling will not, but much flatter. Because the horizontal plane was a visible surface, which suggested the idea of the same distances quite round the eye: but in the vertical plane extended between the eye and the ceiling, there is nothing that affects the sense with an idea of its parts but the common line Oy; consequently the apparent distances of the higher parts of the ceiling will be gradually diminished in ascending from that line. Now when the sky is overcast with clouds of equal gravities, they will all float in the air at equal heights above the earth, and consequently will compose a surface resembling a large ceiling, as flat as the visible surface of the earth. Its concavity therefore is only apparent: and when the heights of the clouds are unequal, since their real shapes and magnitudes are all unknown, the eye can seldom distinguish the unequal distances of those clouds that appear in the same directions, unless when they are very near us, or are driven by contrary currents of the air. So that the visible shape of the whole surface remains alike in both cases. And when the sky is either partly overcast or partly free from clouds, it is matter of fact that we retain much the same idea of its concavity as when it was quite overcast.

The concavity of the heavens appears to the eye, which is the only judge of an apparent figure, to be a less portion of a spherical surface than a hemisphere. Dr Smith says, that the centre of the concavity is much below the eye: and by taking a medium among several observations, he found the apparent distance of its parts at the horizon to be generally between three and four times greater than the apparent distance of its parts overhead. For let the arch ABCD represent the apparent concavity of the sky, O the place of the eye, OA and OC the horizontal and vertical apparent distances, whose proportion is required. First observe when the sun or the moon, or any cloud or star, is in such a situation at B, that the apparent arches BA, BC, extended on each side of this object towards the horizon and zenith, seem equal to the eye; then taking the altitude of the object B with a quadrant, or a cross staff, or finding it by astronomy from the given time of observation, the angle AOB is known. Drawing therefore the line OB in the position thus determined, and taking in it any point B, in the vertical line CO produced downwards, find the centre E of a circle ABC, whose arches BA, BC, intercepted between B and the legs of the right angle AOC, shall be equal to each other; then will this arch ABCD represent 222 Why the concavity of the sky appears less than a hemisphere. Fig. 10.

Blue colour of the Sky. present the apparent figure of the sky. For by the eye we estimate the distance between any two objects in the heavens by the quantity of sky that appears to lie between them; as upon each we estimate it by the quantity of ground that lies between them. The centre E may be found geometrically by constructing a cubic equation, or as quickly and sufficiently exact by trying whether the chords BA, BC, of the arch ABC drawn by conjecture are equal, and by altering its radius BE till they are so. Now in making several observations upon the sun, and some others upon the moon and stars, they seemed to our author to bisect the vertical arch ABC at B, when their apparent altitudes or the angle AOB was about 23 degrees; which gives the proportion of OC to OA as 3 to 10 or as 1 to $3\frac{1}{3}$ nearly. When the altitude of the sun was 30°, the upper arch seemed always less than the under one; and, in our author's opinion, always greater when the sun was about 18 or 20 degrees high.

SECT. IV. *Of the Blue Colour of the Sky, and of Blue and Green Shadows.*

223 Opinions of the ancients respecting the colour of the sky. The opinions of ancient writers concerning the colour of the sky merit no notice. The first who gave any rational explanation was Fromondus. He supposed that the blueness of the sky proceeded from a mixture of the white light of the sun with the black space beyond the atmosphere, where there is neither refraction nor reflection. This opinion very generally prevailed, and was maintained by Otto Guerick and all his contemporaries, who asserted, that white and black may be mixed in such a manner as to make a blue. M. Bouguer had recourse to the vapours diffused through the atmosphere, to account for the reflection of the blue rays rather than any other. He seems however to suppose, that it arises from the constitution of the air itself, from which the fainter-coloured rays are incapable of making their way through any considerable tract of it. Hence he is of opinion, that the colour of the air is properly blue; to which opinion Dr Smith seems also to have inclined.

To this blue colour of the sky is owing the appearance of blue and green shadows in the mornings and

224 Green shadows observed by M. Buffon. evening.—These were first observed by M. Buffon in 1742, when he noticed that the shadows of trees which fell upon a white wall were green. He was at that time standing upon an eminence, and the sun was setting in the cleft of a mountain, so that he appeared considerably lower than the horizon. The sky was clear, excepting in the west, which, though free from clouds, was lightly shaded with vapours, of a yellow colour, inclining to red. Then the sun itself was exceedingly red, and was apparently at least four times as large as he appears to be at mid-day. In these circumstances he saw very distinctly the shadows of the trees, which were 30 or 40 feet from the white wall, coloured with a light green inclining to blue. The shadow of an arbour which was three feet from the wall, was exactly drawn upon it, and looked as if it had been newly painted with verdigrise. This appearance lasted near five minutes; after which it grew fainter, and vanished at the same time with the light of the sun.

225 Blue shadows observed by him. The next morning at sunrise, he went to observe other shadows, upon another white wall; but instead of finding them green as before, he observed that they were of the colour of lively indigo. The sky was serene, except a slight covering of yellowish vapours in the east; and the sun rose behind a hill, so that it was elevated above his horizon. In these circumstances, the blue shadows were only visible three minutes; after which they appeared black, and in the evening of the same day he observed the green shadows exactly as before. On another day at sunset he observed, that the shadows were not green, but of a beautiful sky-blue. He also observed, that the sky was in a great measure free from vapours at that time, and that the sun set behind a rock, so that it disappeared before it came to his horizon. Afterwards he often observed the shadows both at sunrise and sunset; but always perceived them to be blue, though with a great variety of shades.

226 Explanation of these phenomena attempted by Abbé Mazeas. The first person who attempted to explain this phenomenon was the Abbé Mazeas. He observed, that when an opaque body was illuminated by the moon and a candle at the same time, and the two shadows were cast upon the same white wall, that which was enlightened by the candle was reddish, and that which was enlightened by the moon was blue. He supposed, however, the change of colour to be occasioned by the diminution of the light; but M. Melville, and M. Bouguer,

227 Melville's and Bouguer's explanation. both independent of one another, seem to have hit upon the true cause of this curious appearance, and which has been already hinted at. The former of these gentlemen, in his attempts to explain the blue colour of the sky, observes, that since it is certain that no body assumes any particular colour, but because it reflects one sort of rays more abundantly than the rest; and since it cannot be supposed that the constituent parts of pure air are gross enough to separate any colours of themselves; we must conclude with Sir Isaac Newton, that the violet and blue making rays are reflected more copiously than the rest, by the finer vapours diffused through the atmosphere, whose parts are not big enough to give them the appearance of visible opaque clouds. And he shows that in proper circumstances, the bluish colour of the sky light may be actually seen on bodies illuminated by it, as, he says, it is objected should always happen upon this hypothesis. For that if, on a cloudless day, a sheet of white paper be exposed to the sun's beams, when any opaque body is placed upon it, the shadow which is illuminated by the sky only will appear remarkably bluish compared with the rest of the paper, which receives the sun's direct rays.

M. Bouguer, who has taken the most pains with this subject, observes, that as M. Buffon mentions the shadows appearing green only twice, and that at all other times they were blue, this is the colour which they regularly have, and that the blue was changed into green by some accidental circumstance. Green, he says, is only a composition of blue and yellow, so that this accidental change may have arisen from the mixture of some yellow rays in the blue shadow; and that perhaps the walls might have had that tinge, so that the blue is the only colour for which a general reason is required. This, he says, must be derived from the colour of pure air, which always appears blue, and which always reflects that colour upon all objects without distinction; but which is too faint to be perceived when our eyes are strongly affected by the light of the sun, reflected from other objects around us.

To

Blue colour of the Sky.

To confirm this hypothesis, he adds some interesting observations of his own, in which this appearance is agreeably diversified. Being at the village of Boucholtz in July 1764, he observed the shadows projected on the white paper of his pocket-book when the sky was clear.

228 Curious observations on this subject.

At half an hour past six in the evening, when the sun was about 4° high, he observed that the shadow of his finger was of a dark gray, while he held the paper opposite to the sun; but when he inclined it almost horizontally, the paper had a bluish cast, and the shadow upon it was of a beautiful bright blue.

When his eye was placed between the sun and the paper laid horizontally, it always appeared of a bluish cast; but when he held the paper thus inclined between his eye and the sun, he could distinguish, upon every little eminence occasioned by the inequality of the surface of the paper, the chief prismatic colours. This multitude of coloured points, red, yellow, green, and blue, almost effaced the natural colour of the objects.

At 6^h 45′ the shadows began to be blue, even when the rays of the sun fell perpendicularly. The colour was the most lively when the rays fell upon it at an angle of 45°; but with a less inclination of the paper, he could distinctly perceive, that the blue shadow had a border of a stronger blue on that side which looked towards the sky, and a red border on that side which was turned towards the earth. To see these borders, it was necessary to place the body that made the shadow very near the paper; and the nearer it was, the more sensible was the red border. At the distance of three inches, the whole shadow was blue. At every observation, after having held the paper towards the sky, he turned it towards the earth, which was covered with verdure; holding it in such a manner, that the sun might shine upon it while it received the shadows of various bodies; but in this position he could never perceive the shadow to be blue or green at any inclination with respect to the sun's rays.

At seven o'clock, the altitude of the sun being still about two degrees, the shadows were of a bright blue, even when the rays fell perpendicularly upon the paper, but were brightest when it was inclined 45°. At this time he was surprised to observe, that a large tract of sky was not favourable to the production of this blue colour, and that the shadow falling upon the paper placed horizontally was not coloured, or at least the blue was very faint. This singularity, he concluded, arose from the small difference between the light of that part of the paper which received the rays of the sun and that which was in the shade in this situation. In a situation precisely horizontal, the difference would vanish, and there could be no shadow. Thus too much or too little of the sun's light produced, but for different reasons, the same effect; for they both made the blue light reflected from the sky become insensible. This gentleman never saw any green shadows; but supposes that the cause of those seen by Buffon might be the mixture of yellow rays, reflected from the vapours, which he observes were of that colour.

229 Blue shadows not confined to the mornings and evenings.

These blue shadows, our author observes, are not confined to the times of the sunrising and sunsetting; on the 19th of July, when the sun has the greatest force, he observed them at three o'clock in the afternoon, but the sun at that time shone through a mist.

If the sky be clear the shadows begin to be blue, when, if they be projected horizontally, they are eight times as long as the height of the body that produces them, that is, when the altitude of the sun's centre is 7° 8′. This observation, he says, was made in the beginning of August.

Besides these coloured shadows, which are produced by the interception of the direct rays of the sun, our author observed others similar to them at every hour of the day, in rooms into which the light of the sun was reflected from some white body, if any part of the clear sky could be seen from the place, and all unnecessary light was excluded as much as possible. He remarks, that the blue shadows may be seen at any hour of the day, even with the direct light of the sun; and that this colour will disappear in all those places of the shadow from which the blue sky cannot be seen.

All the observations that our author made upon the yellow or reddish borders of shadows above mentioned, led him to conclude, that they were occasioned by the interception of the sky light, whereby part of the shadow was illuminated either by the red rays reflected from the clouds, when the sun is near the horizon, or from some terrestrial bodies in the neighbourhood. This conjecture is favoured by the necessity he was under of placing any body near the paper, in order to produce this bordered shadow, as he says it is easily demonstrated, that the interception of the sky light can only take place when the breadth of the opaque body is to its distance from the white ground on which the shadow falls, as twice the sine of half the amplitude of the sky to its cosine.

230 Another kind of shadows.

At the conclusion of his observations on these blue shadows, he gives a short account of another kind of them, which, he supposes to have the same origin. These he often saw early in the spring when reading by the light of a candle in the morning, and consequently with the twilight mixed with that of his candle. In these circumstances, the shadow made by intercepting the light of his candle, at the distance of about six feet, was of a beautiful and clear blue, which became deeper as the opaque body which made the shadow was brought nearer to the wall, and was exceedingly deep at the distance of a few inches only. But where the day light did not come, the shadows were all black without the least mixture of blue.

231 New explanation of the colour of the sky.

The explanations of the blue colour of the sky given by Newton and Bouguer are far from satisfactory, and we presume that the following method of accounting for that phenomenon affords the true explanation. The light which flows from any portion of the blue sky is obviously reflected light, which is thrown out into the atmosphere in all directions by the earth, and the clouds and vapours which surround it. The red or least refrangible rays of this light having a greater momentum than the blue or most refrangible rays, penetrate much farther into the atmosphere, and though a few may be reflected, yet almost all of them will be absorbed or lost before they can return to the earth's surface. On the contrary, the blue rays, having less momentum, are not capable of penetrating so far into a resisting medium, and are therefore reflected to the earth's surface, and give a blue colour to the expanse of the heavens. The blue colour of the sky is exactly the converse of the red colour which is perceived at great depths in the sea, and of the red hue of the morning and evening clouds. These

phenomena

phenomena being produced by tranſmitted or refracted light; the red rays make their way through the medium to the obſerver's eye, while the blue ones are reflected or abſorbed.

SECT. V. *Of the Irradiations of the Sun's Light appearing through the interſtices of the Clouds.*

THIS is an appearance which every one muſt have obſerved when the ſky was pretty much overcaſt, and the clouds have many breaks or openings. At that time ſeveral large beams of light, ſomething like the appearance of the light of the ſun admitted into a ſmoky room, will be ſeen generally with a very conſiderable degree of divergency, as if the radiant point was ſituated at no great diſtance above the clouds. Dr Smith obſerves that this appearance is one of thoſe which ſerve to demonſtrate that very high and remote objects in the heavens do not appear to us in their real ſhapes and poſitions, but according to their perſpective projections in the apparent concavity of the ſky. He acquaints us, that though theſe beams are generally ſeen diverging, as repreſented in fig. 11. it is not always the caſe. He himſelf, in particular, once ſaw them converging towards a point diametrically oppoſite to the ſun: for, as near as he could conjecture, the point to which they converged was ſituated as much below the horizon as the ſun was then elevated above the oppoſite part of it. This part is repreſented by the line tDt, and the point below it in oppoſition to the ſun is E; towards which all the beams vt, vt, &c. appeared to converge.

Plate CCCLXXXIV. fig. 11.

232 Converging irradiations obſerved by Dr Smith.

Fig. 21.

Perceiving that the point of convergency was oppoſite to the ſun, he ſuſpected that this unuſual phenomenon was but a caſe of the uſual *apparent divergence* of the beams of the ſun from his apparent place among the clouds, as repreſented in fig. 11.; for though nothing is more common than for rays to diverge from a luminous body, yet the divergence of theſe beams in ſuch large angles is not real, but apparent. Becauſe it is impoſſible for the direct rays of the ſun to croſs one another at any point of the apparent concavity of the ſky, in a greater angle than about half a degree. For the diameter of the earth being ſo very ſmall, in compariſon to the diſtance of the ſun, as to ſubtend an angle at any point of his body of about 20 ſeconds; and the diameter of our viſible horizon being extremely ſmaller than that of the earth; it is evident, that all the rays which fall upon the horizon from any given point of the ſun, muſt be inclined to each other in the ſmalleſt angles imaginable: the greateſt of them being as much ſmaller than that angle of $20''$ as the diameter of the viſible horizon is ſmaller than that of the earth. All the rays that come to us from any given point of the ſun may therefore be conſidered as parallel; as the rays eBg from the point e, or fBh from the oppoſite point f; and conſequently the rays of theſe two pencils that come from oppoſite points of the ſun's real diameter, and croſs each other in the ſun's apparent place B among the clouds, can form no greater an angle with each other than about half a degree; this angle of their interſection eBf being the ſame as the ſun would ſubtend to an eye placed among the clouds at B, or (which is much the ſame) to an eye at O upon the ground. Becauſe the ſun's real diſtance OS is inconceivably greater than his apparent diſtance OB. Therefore the rays of the ſun, as Bg, Bh, do really diverge from his apparent place B in no greater angles gBh than about half a degree. Nevertheleſs they appear to diverge from the place B in all poſſible angles, and even in oppoſite directions. Let us proceed then to an explanation of this apparent divergence, which is by no means ſelf-evident; though at firſt ſight we are apt to think it is, by not diſtinguiſhing the vaſt difference between the true and apparent diſtances of the ſun.

233 The phenomenon explained by him.

Fig. 13.

Suppoſing all the rays of the ſun to fall accurately parallel to each other upon the viſible horizon, as they do very nearly, yet in both caſes they muſt appear to diverge in all poſſible angles. Let us imagine the heavens to be partly overcaſt with a ſpacious ſtratum of broken clouds, v, v, v, &c. parallel to the plane of the viſible horizon, repreſented by the line AOD; and when the ſun's rays fall upon theſe clouds in the parallel lines sv, sv, &c. let ſome of them paſs through their interſtices in the lines vt, vt &c. and fall upon the plane of the horizon at the places t, t, &c. And ſince the reſt of the incident rays sv, sv, are ſuppoſed to be intercepted from the place of the ſpectator at O by the cloud x, and from the intervals between the tranſmitted rays vt, vt, &c. by the clouds v, v, &c. a ſmall part of theſe latter rays vt, vt, when reflected every way from ſome certain kind of thin vapours floating in the air, may undoubtedly be ſufficient to affect the eye with an appearance of lights and ſhades, in the form of bright beams in the places vt, vt, &c. and of dark ones in the intervals between them; juſt as ſimilar beams of light and ſhade appear in a room by reflections of the ſun's rays from ſmoke or duſt flying within it; the lights and ſhades being here occaſioned by the tranſmiſſion of the rays through ſome parts of the window, and by their interruption at other parts.

Fig. 14.

Now, if the apparent concavity of this ſtratum of clouds v, v, to the eye at O, be repreſented by the arch ABCD, and be cut in the point B by the line OBx parallel to the beams tv; it will be evident by the rules of perſpective, that theſe long beams will not appear in their real places, but upon the concave AB CD diverging every way from the place B, where the ſun himſelf appears, or the cloud x that covers his body, as repreſented ſeparately in full view in fig. 11.

Fig. 11.

And for the ſame reaſon, if the line BO be produced towards E, below the plane of the horizon AOD, and the eye be directed towards the region of the ſky directly above E, the lower ends of the ſame real beams vt, vt, will now appear upon the part DF of this concave; and will ſeem to converge towards the point E, ſituated juſt as much below the horizon as the oppoſite point B is above it: which is ſeparately repreſented in full view in fig. 12.

Fig. 12.

For if the beams vt, vt, be ſuppoſed to be viſible throughout their whole lengths, and the eye be directed in a plane perpendicular to them, here repreſented by the line OF; they and their intervals will appear broadeſt in and about this plane, becauſe theſe parts of of them are the neareſt to the eye; and therefore their remoter parts and intervals will appear gradually narrower towards the oppoſite ends of the line BE. As a farther illuſtration of this ſubject, we may conceive the ſpectator at O to be ſituated upon the top of ſo large a deſcent OHI towards a remote valley IK, and the ſun to be ſo very low, that the point E, oppoſite to him, may be ſeen above the horizon of this ſhady valley.

Irradiations of the Sun's Light, &c.

ley. In this caſe it is manifeſt, that the ſpectators at O would now ſee theſe beams converging ſo far as to meet each other at the point E in the ſky itſelf.

234 Not obſerved by moon light.

This phenomenon is not ſeen in moonlight, probably becauſe her light is too weak after reflections from any kind of vapours, to cauſe a ſenſible appearance of lights and ſhades ſo as to form theſe beams. And in the phenomenon of fig. 12. the converging ſunbeams towards the point below the horizon were not quite ſo bright and ſtrong as thoſe uſually are that diverge from him; and the ſky beyond them appeared very black (ſeveral ſhowers having paſſed that way), which certainly contributed to this appearance. Hence it is probable that the thinneſs and weakneſs of the reflected rays from the vapours oppoſite the ſun, is the chief cauſe that this appearance is ſo very uncommon in compariſon to that of diverging beams. For as the region of the ſky round about the ſun is always brighter than the oppoſite one, ſo the light of the diverging beams ought alſo to be brighter than that of the converging ones. For, though rays are reflected from rough unpoliſhed bodies in all directions, yet more of them are reflected forwards obliquely, than are reflected more directly backwards. Beſides, in the preſent caſe, the incident rays upon the oppoſite region to the ſun, are more diminiſhed by continual reflections from a longer tract of the atmoſphere, than the incident rays upon the region next the ſun.

235 The phenomenon of diverging beams more frequent in ſummer than in winter.

The common phenomenon of diverging beams is more frequent in ſummer than in winter, and alſo when the ſun is lower than when higher up; probably becauſe the lower vapours are denſer, and therefore more ſtrongly reflective than the higher; becauſe the lower ſky light is not ſo bright as the upper; becauſe the air is generally more quiet in the mornings and evenings than about noon-day; and laſtly, becauſe many ſorts of vapours are more plentifully exhaled in ſummer than in winter, from many kinds of volatile vegetables; which vapours, when the air is cooled and condenſed in the mornings and evenings, may become denſe enough to reflect a ſenſible light.

Sect. VI. *Of the Illumination of the Earth's Shadow in Lunar Eclipſes.*

The ancient philoſophers, who knew nothing of the refractive power of the atmoſphere, were much perplexed to account for the body of the moon being viſible when totally eclipſed. At ſuch times ſhe generally appears of a dull red colour, like tarniſhed copper. This,

236 Why the moon is viſible when totally eclipſed.

they thought, was the moon's native light, by which ſhe became viſible when hid from the brighter light of the ſun. Plutarch, indeed, attributes this appearance to the light of the fixed ſtars reflected to us by the moon; but this is too weak to produce the effect. The true cauſe of it is the ſcattered beams of the ſun bent into the earth's ſhadow by refractions through the atmoſphere in the following manner.

Plate CCCLXXXV. fig. 1.

Let the body of the ſun be repreſented by the circle *ab*, and that of the earth by *cd*; and let the lines *ace* and *bde* touch them both, and meet in *e* beyond the earth; then the angular ſpace *ced* will repreſent the conical figure of the earth's ſhadow, which would be totally dark, were none of them bent into it by the refraction of the atmoſphere. The rays *a h* and *b i*, which touch its oppoſite ſides, will proceed unrefracted, and meet each other at *k*. Then the two neareſt rays to theſe that flow within them, from the ſame points *a* and *b*, being refracted inwards through the margin of the atmoſphere, will croſs each other at a point *l*, ſomewhat nearer to the earth than *k*; and in like manner, two oppoſite rays next within the two laſt will croſs each other at a point *m*, ſomewhat nearer to the earth than *l*, having ſuffered greater refractions, by paſſing through longer and denſer tracts of air lying ſomewhat nearer to the earth. The like approach of the ſucceſſive interſections *k*, *l*, *m*, is to be underſtood of innumerable couples of rays, till you come to the interſection *n* of the two innermoſt; which we may ſuppoſe juſt to touch the earth at the points *o* and *p*. It is plain then, that the ſpace bounded by theſe rays *o n*, *n p*, will be the only part of the earth's ſhadow wholly unenlightened. Let *f m g* be part of the moon's orbit when it is neareſt the earth, at a time when the earth's dark ſhadow *onp*, is longeſt: in this caſe, the ratio of *t m* to *t n* is about 4 to 3; and conſequently the moon, though centrally eclipſed at *m*, may yet be viſible by means of the ſcattered rays, firſt tranſmitted to the moon by refraction through the atmoſphere, and thence reflected to the earth.

Illumination of the Shadow of the Earth.

Fig. 2.

For let the incident and emergent parts *a q*, *r n*, of the ray *a q o r n*, that juſt touches the earth at *o*, be produced till they meet at *u*, and let *a q u* produced meet the axis *s t* produced in *x*; and joining *u s* and *u m*, ſince the refractions of a horizontal ray paſſing from *o* to *r*, or from *o* to *q*, would be alike and equal, the external angle *n u x* is double the quantity of the uſual refraction of a horizontal ray; and the angle *a u s* is the apparent meaſure of the ſun's ſemidiameter ſeen from the earth; and the angle *u s t* is that of the earth's ſemidiameter *t u* ſeen from the ſun (called his *horizontal parallax*); and laſtly, the angle *u m t* is that of the earth's ſemidiameter ſeen from the moon (called her *horizontal parallax*); becauſe the elevation of the point *u* above the earth is too ſmall to make a ſenſible error in the quantity of theſe angles; whoſe meaſures by aſtronomical tables are as follow;

		′ ″	
Sun's leaſt app. ſemidiam.	$= a u s =$	15—50	
Sun's horizontal parallax	$= u s t =$	00—10	
Their difference * is -	$= t x u =$	15—40	* *Eucl.* I. Prop. xxxii.
Twice horizontal refraction	$= n u x =$	67—30	
Their ſum † is - -	$= t n u =$	83—10	† *Ibid.*
Moon's greateſt horiz. parallax	$= t m u =$	62—10	

Therefore (by a preceding prop.) we have $t m : t n =$ (ang. tnu : ang. $tmu = 83'—10''$: $62'—10'' =$)4 : 3 in round numbers; which was to be proved. It is eaſy to collect from the moon's greateſt horizontal parallax of 62′—10″, that her leaſt diſtance *t m* is about $55\frac{1}{3}$ ſemidiameters of the earth; and therefore the greateſt length *t n* of the dark ſhadow, being three quarters of *t m*, is about $41\frac{1}{2}$ ſemidiameters.

The difference of the laſt-mentioned angles *t n u*, *t m u* is $m u n = 21'$, that is, about two thirds of 31′—40″, the angle which the whole diameter of the ſun ſubtends at *u*. Whence it follows, that the middle point *m* of the moon centrally eclipſed, is illuminated by rays which come from two-thirds of every diameter of the ſun's diſk, and paſs by one ſide of the earth; and alſo by rays that come from the oppoſite two-thirds of every

Illumination of the Shadow of the Earth.

every one of the said diameters, and pass by the other side of the earth. This will appear by conceiving the ray $a\,q\,o\,r\,n$ to be inflexible, and its middle point a to slide upon the earth, while the part $r\,n$ is approaching to touch the point m; for then the opposite part $q\,a$ will trace over two thirds of the sun's diameter. The true proportion of the angles $n\,u\,m$, $a\,u\,s$, could not be preserved in the scheme, by reason of the sun's immense distance and magnitude with respect to the earth.

Fig. 3. Having drawn the line $a\,t\,\alpha$, it may be observed, that all the incident rays, as $a\,q$, $\alpha\,\varkappa$, flowing from any one point of the sun to the circumference of the earth, will be collected to a focus α, whose distance $t\,\alpha$ is less than $t\,m$ in the ratio of 62 to 67 nearly; and thus an image of the sun will be formed at $\alpha\,\beta$, whose rays will diverge upon the moon. For the angle $t\,\alpha\,u$ is the difference of the angles $\varkappa\,u\,\alpha$, $u\,\alpha\,t$ found above; and $t\,\alpha : t\,m =$ ang. $t\,m\,u$: ang. $t\,\alpha\,u = 62'$—$10''$: 67—$30''$.

The rays that flow next above $a\,q$ and $a\,\varkappa$, by passing through a rarer part of the atmosphere, will be united at a point in the axis $a\,t\,\alpha$ farther from the earth than the last focus α; and the same may be said of the rays that pass next above these, and so on; whereby an infinite series of images of the sun will be formed, whose diameters and degrees of brightness will increase with their distances from the earth.

Hence it is manifest why the moon eclipsed in her perigee appears always duller and darker than in her apogee. The reason why her colour is always of the copper kind, between a dull red and orange, seems to be this: The blue colour of a clear sky shows that the blue rays are more copiously reflected from pure air than those of any other colour; consequently they are less copiously transmitted through it among the rest that come from the sun, and so much the less as the tract of air through which they pass is the longer. Hence the common colour of the sun and moon is whitest in the meridian, and grows gradually more inclined to diluted yellow, orange, and red, as they descend lower, that is, as the rays are transmitted through a longer tract of air; which tract being still lengthened in passing to the moon and back again, causes a still greater loss of the blue rays in proportion to the rest; and so the resulting colour of the transmitted rays must lie between a dark orange and red, according to Sir Isaac Newton's rule for finding the result of a mixture of colours. The circular edge of the shadow in a partial eclipse appears red; because the red-making rays are the least refracted of all others, and consequently are left alone in the conical surface of the shadow, all the rest being refracted into it.

Illumination of the Shadow of the Earth.

237 Why the moon appears duller when eclipsed in her perigee than in her apogee.

Dr Herschel, who believes that the moon is phosphorescent, and that she shines by her native light, when totally eclipsed by the sun, has endeavoured to shew, by calculation, that the light refracted by the atmosphere cannot in some cases fall upon the moon.

Part III. On the CONSTRUCTION of OPTICAL INSTRUMENTS.

Chap. I. *Description of Optical Instruments.*

OF the mechanism of optical instruments, particular accounts are given in this work under their respective names. These it would be improper to repeat; but as it belongs to the science of optics to explain, by the laws of refraction and reflection, the several phenomena which those instruments exhibit, we must here enumerate the instruments themselves, omitting entirely, or stating very briefly, such facts as are given at large in other places.

Sect. I. *The Multiplying Glass.*

Plate CCCLXXXVI. fig. 1.

238 Multiplying glass.

THE multiplying glass is made by grinding down the convex side $h\,i\,k$ of a plano-convex glass AB, into several flat surfaces, as $h\,b$, $b\,l\,d$, $d\,k$. An object C will not appear magnified when seen through this glass by the eye at H; but it will appear multiplied into as many different objects as the glass contains plane surfaces. For, since rays will flow from the object C to all parts of the glass, and each plane surface will refract these rays to the eye, the same object will appear to the eye in the direction of the rays which enter it through each surface. Thus, a ray $g\,i$ H, falling perpendicularly on the middle surface, will go through the glass to the eye without suffering any refraction; and will therefore show the object in its true place at C: whilst a ray $a\,b$ flowing from the same object, and falling obliquely on the plane surface $b\,h$, will be refracted in the direction $b\,e$, by passing through the glass; and, upon leaving it, will go on to the eye in the direction e H; which will make the same object C appear also at E, in the direction of the ray H e, produced in the right line H $e\,n$. And the ray $c\,d$, flowing from the object C, and falling obliquely on the plane surface $d\,k$, will in the same way be refracted to the eye at H; which will cause the same object to appear at D, in the direction H $f\,m$.—If the glass be turned round the line $g\,l$H, as an axis, the object C will keep its place, because the surface $b\,l\,d$ is not removed; but all the other objects will seem to go round C, because the oblique planes, on which the rays $a\,b\,c\,d$ fall, will turn round by the motion of the glass.

Sect. II. *Mirrors.*

It has been already observed, that there are three kinds of mirrors principally used in optical experiments (See Catoptrics, Sect. I.); the plane mirror, the spherical convex mirror, and the spherical concave mirror. Of these the plane mirror first claims our attention, as it is more common, and of greater antiquity, than the other two. We have shewn that the image reflected by this mirror appears as far behind the surface as the object is before it; that the image will appear of the same size and in the same position with the object; that every plane mirror will reflect an image of twice its own length and breadth; and that in certain circumstances it will reflect several images of the same object. These phenomena we shall now explain by the laws of reflection.

Let AB be an object placed before the reflecting surface $g\,h\,i$ of the plane mirror CD; and let the eye be at o. Let Ah be a ray of light flowing from the top A of the object, and falling upon the mirror at h, and $h\,m$ be a perpendicular to the surface of the mirror at h; the ray A h will be reflected from the mirror to the eye at o, making an angle $m\,h\,o$ equal to the angle Ahm;

Plate CCCLXXXVII. Fig. 2.

Optical Instruments.

A*hm*: then will the top of the image E appear to the eye in the direction of the reflected ray *oh* produced to E, where the right line A*p*E, from the top of the object, cuts the right line *oh*E, at E. Let B*i* be a ray of light issuing from the foot of the object at B to the mirror at *i*; and *n i* a perpendicular to the mirror from the point *i*, where the ray B *i* falls upon it; this ray will be reflected in the line *io*, making an angle *nio* equal to the angle B*in*, with that perpendicular, and entering the eye at *o*; then will the foot F of the image appear in the direction of the reflected ray *oi*, produced to F, where the right line BF cuts the reflected ray produced to F. All the other rays that flow from the intermediate points of the object AB, and fall upon the mirror between *h* and *i*, will be reflected to the eye at *o*; and all the intermediate points of the image EF will appear to the eye in the direction of these reflected rays produced. But all the rays that proceed from the object and fall upon the mirror above *h*, will be reflected back above the eye at *o*; and all the rays that flow from the object, and fall upon the mirror below *i*, will be reflected back below the eye at *o*; so that none of the rays that fall above *h*, or below *i*, can be reflected to the eye at *o*; and the distance between *h* and *i* is equal to half the length of the object AB.

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Size of a looking-glass in which a man may see his whole image.
Fig. 3.

Hence it appears, that if a man sees his whole image in a plane looking-glass, the part of the glass that reflects his image must be just half as long and half as broad as himself, let him stand at any distance from it whatever; and that his image must appear just as far behind the glass as he is before it. Thus, the man AB viewing himself in the plane mirror CD, which is just half as long as himself, sees his whole image as at EF, behind the glass, exactly equal to his own size. For a ray AC proceeding from his eye at A, and falling perpendicularly upon the surface of the glass at C, is reflected back to his eye, in the same line CA; and the eye of his image will appear at E, in the same line produced to E, beyond the glass. And a ray BD, flowing from his foot, and falling obliquely on the glass at D, will be reflected as obliquely on the other side of the perpendicular *ab*D, in the direction DA; and the foot of his image will appear at F, in the direction of the reflected ray AD, produced to F, where it is cut by the right line BGF, drawn parallel to the right line ACE; just the same as if the glass were taken away, and the real man stood at F, equal in size to the man standing at B: For to his eye at A, the eye of the other man at E would be seen in the direction of the line ACE; and the foot of the man at F would be seen by the eye A, in the direction of the line ADF.

If the glass be brought nearer the man AB, suppose to *cb*, he will see his image at CDG: for the reflected ray CA (being perpendicular to the glass) will show the eye of the image at C; and the incident ray B*b*, being reflected in the line *b*A, will show the foot of his image at G; the angle of reflection *ab*A being always equal to the angle of incidence B*ba*; and so of all the intermediate rays from A to B. Hence, if the man AB advances towards the glass CD, his image will approach towards it; and if he recedes from the glass, his image will also recede from it.

If the object be placed before a common looking-glass, and viewed obliquely, three, four, or more images of it, will appear behind the glass.

Plate CCCLXXXII. fig. 11.

To explain this, let ABCD represent the glass; and let EF be the axis of a pencil of rays flowing from E, a point in an object situated there. The rays of this pencil will in part be reflected at F, suppose into the line FG. What remains will (after refraction at F, which we do not consider here) pass on to H; from whence (on account of the quicksilver which is spread over the second surface of the glass) they will be strongly reflected to K, where part of them will emerge and enter an eye at L. By this means one representation of the point E will be formed in the line LK produced, suppose in M: Again, Another pencil, whose axis is EN, first reflected at N, then at O, and afterwards at P, will form a second representation of the same point at Q: And, thirdly, Another pencil, whose axis is ER, after successive reflections at the several points R, S, H, T, V, will exhibit a third representation of the same point at X; and so on *ad infinitum*. The same being true of each point in the object, the whole will be represented in the like manner; but the representations will be faint, in proportion to the number of reflections which the rays suffer, and the length of their progress within the glass. We may add to these another representation of the same object in the line LO produced, made by such of the rays as fall upon O, and are thence reflected to the eye at L. This experiment may be tried by placing a candle before the glass as at E, and viewing it obliquely, as from L.

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Why three or four images of objects are seen in plane mirrors.

2. *Of Concave Mirrors.* The effects of these in magnifying and diminishing objects, have in general been already explained; but in order to understand the nature of reflecting telescopes, it will still be proper to subjoin the following particular description of the effects of concave mirrors.

Plate CCCLXXXVII. fig. 4.

When parallel rays, as *d f a*, C *m b*, *e l c*, fall upon a concave mirror A*b*B, they will be reflected back from that mirror, and meet in a point *m*, at half the distance of the surface of the mirror from C the centre of its concavity; for they will be reflected at as great an angle from a perpendicular to the surface of the mirror, as they fell upon it with regard to that perpendicular, but on the other side thereof. Thus, let C be the centre of concavity of the mirror A*b*B; and let the parallel rays *d f a*, C *m b*, and *e l c*, fall upon it at the points *a*, *b*, and *c*. Draw the lines C *i a*, C *m b*, and C *h c*, from the centre C to these points; and all these lines will be perpendicular to the surface of the mirror. Make the angle C *a h*=*d a* C, and draw the line *a m h*, which will be the direction of the ray *d f a*, after it is reflected from the point *a* of the mirror; so that the angle of incidence *d a* C=C *a h*, the angle of reflection; the rays making equal angles with the perpendicular C *i a* on its opposite sides.

Draw also the perpendicular C *h c* to the point *c*, where the ray *e l c* touches the mirror; and having made the angle C *c i*=C *c e*, draw the line *c m i*, which will be the course of the ray *e l c*, after it is reflected from the mirror. The ray C *m b* passing through the centre of concavity of the mirror, and falling upon it at *b*, is perpendicular to it; and is therefore reflected back from it in the same line *b m* C. All these reflected rays meet in the point *m*; and in that point the image of the body which emits the parallel rays *d a*, C *b*, and *e c*, will be formed; which point is distant from the mirror equal to half the radius *b m* C of its concavity.

As

Optical Instruments.

As the rays which proceed from any celeſtial object may be eſteemed parallel, the image of that object will be formed at *m*, when the reflecting ſurface of the concave mirror is turned directly to the object. Hence the focus *m* of parallel rays is not in the centre of the mirror's concavity, but half way between the mirror and that centre.

The rays which proceed from any remote terreſtrial object are not ſtrictly parallel, but come diverging to it, in ſeparate pencils, from each point of the ſide of the object next the mirror; and therefore they will not be converged to a point at the diſtance of half the radius of the mirror's concavity from its reflecting ſurface, but into ſeparate points at a little greater diſtance from the mirror. The nearer the object is to the mirror, the farther theſe points will be from it; and an inverted image of the object will be formed in them, which will ſeem to hang in the air, and will be ſeen by an eye placed beyond it (with regard to the mirror) in all reſpects ſimilar to the object, and as diſtinct as the object itſelf.

241 Aerial images formed by concave mirrors. Fig. 5.

Let A*c*B be the reflecting ſurface of a mirror, whoſe centre of concavity is at C; and let the upright object DE be placed beyond the centre C, and ſend out a conical pencil of diverging rays from its upper extremity D, to every point of the concave ſurface of the mirror A*c*B. But to avoid confuſion, we only draw three rays of that pencil, as DA, D*c*, DB.

From the centre of concavity C, draw the three right lines CA, C*c*, CB, touching the mirror in the ſame points where the three rays touch it; and all theſe lines will be perpendicular to the ſurface of the mirror. Make CA*d*=DAC, and draw the right line A*d* for the courſe of the reflected ray DA: make C*cd*=D*c*C, and draw the right line *cd* for the courſe of the reflected ray D*d*: make alſo CB*d*=DBC, and draw the right line B*d* for the courſe of the reflected ray DB. All theſe reflected rays will meet in the point *d*, where they will form the extremity *d* of the inverted image *ed* ſimilar to the extremity D of the upright object DE.

If the pencil of rays E*f*, E*g*, E*h*, be alſo continued to the mirror, and their angles of reflection from it be made equal to their angles of incidence upon it, as in the former pencil from D, they will all meet at the point *e* by reflection, and form the extremity *e* of the image *ed*, ſimilar to the extremity E of the object DE. And as each intermediate point of the object, between D and E, ſends out a pencil of rays in like manner to every part of the mirror, the rays of each pencil will be reflected back from it, and meet in all the intermediate points between the extremities *e* and *d* of the image; and ſo the whole image will be formed in an inverted poſition not at *i*, half the diſtance of the mirror from its centre of concavity C, but at a greater diſtance between *i* and the object DE.

This being well underſtood, the reader will eaſily underſtand how the image is formed by the large concave mirror of the reflecting teleſcope, when he comes to the deſcription of that inſtrument.

When the object is more remote from the mirror than its centre of concavity C, the image will be leſs than the object, and between the object and mirror: when the object is nearer than the centre of concavity, the image will be more remote and bigger than the object. Thus, if ED be the object, *de* will be its image: For, as the object recedes from the mirror, the image approaches nearer to it; and as the object approaches nearer to the mirror, the image recedes farther from it; on account of the leſſer or greater divergency of the pencils of rays which proceed from the object: for the leſs they diverge, the ſooner they are converged to points by reflection; and the more they diverge, the farther they proceed before they meet.

If the radius of the mirror's concavity, and the diſtance of the object after refraction, be known, the diſtance of the image from the mirror is found by this rule: Divide the product of the diſtance and radius by double the diſtance made leſs by the radius, and the quotient is the diſtance required.

If the object be in the centre of the mirror's concavity, the image and object will be coincident, and equal in bulk.

If a man place himſelf directly before a large concave mirror, but farther from it than its centre of concavity, he will ſee an inverted image of himſelf in the air, between him and the mirror, and of a leſs ſize than himſelf. If he holds out his hand towards the mirror, the hand of the image will come out towards his hand, and coincide with it, of an equal bulk, when his hand is in the centre of concavity; and he will imagine he may ſhake hands with his image. If he reaches his hand farther, the hand of the image will paſs by his hand, and come between his hand and his body: and if he moves his hand towards either ſide, the hand of the image will move towards the other; ſo that whatever way the object moves, the image will move the contrary. All the while a byſtander will ſee nothing of the image, becauſe none of the reflected rays that form it enter his eyes.

SECT. III. *Camera Obſcura.*

THE camera obſcura having already been fully deſcribed under the word DIOPTRICS, we ſhall at preſent only direct the readers attention to an improvement which has lately been made upon this amuſing inſtrument.

"The improvements (ſays Dr Brewſter) which have been made upon the camera obſcura ſince its firſt invention, regard chiefly its external form; and no attempts have been made to increaſe the brilliancy and diſtinctneſs of the image. When we compare the picture of external objects, which is formed in a dark chamber by the object-glaſs of a common refracting teleſcope, with that which is formed with an achromatic object-glaſs, we ſhall find the difference between their diſtinctneſs much leſs than we ſhould have at firſt expected. Although the achromatic lens forms an image of the minuteſt parts of the landſcape, yet when this image is received on paper, theſe minute parts are obliterated by the ſmall hairs and aſperities on its ſurface, and the effect of the picture is very much impaired. In the Royal Obſervatory at Greenwich the image is received upon a large concave piece of ſtucco; but this ſubſtance does not ſeem to be more favourable for the reception of images than a paper ground. In order to obviate theſe imperfections, I tried a number of white ſubſtances of different degrees of ſmoothneſs, and ſeveral metallic ſurfaces with different degrees of poliſh, but did not ſucceed in finding any ſurface ſuperior to paper. I happened, however, to receive the image on the ſilvered back of a looking glaſs, and was ſurpriſed at the brilliancy and diſtinctneſs with which external objects were repreſented. The little ſpherical protuberances, however,

ever, which ariſe from the roughneſs of the tinfoil have a tendency to detract from the preciſion of the image, and certainly injure it conſiderably when examined narrowly with the eye. In order to remove theſe ſmall eminences, I ground the ſurface carefully with a bed of hones which I had uſed for working the plane ſpecula of Newtonian teleſcopes. By this operation, which is exceedingly delicate, and may be performed without injuring the mirror, I obtained a ſurface finely adapted for the reception of images. The minute parts of the landſcape, when received on this ſubſtance, are formed with ſo much preciſion, and the brilliance of the colouring is ſo uncommonly fine, as to equal, if not ſurpaſs the images formed in the air by means of concave ſpecula. Notwithſtanding the bluiſh colour of the metallic ground, white objects are repreſented in their true colour, and the verdure of the foliage is ſo rich and vivid, that the image ſeems to ſurpaſs in beauty even the object itſelf. On account of the metallic luſtre of the ſurface, the diſtinctneſs of the image will always be greateſt when the eye of the obſerver is placed in the direction of the reflected rays.

The common portable camera obſcura, which has already been deſcribed (ſee DIOPTRICS), is neceſſarily on a ſmall ſcale, and has many diſadvantages. Theſe diſadvantages are completely remedied in the camera obſcura, invented by the Rev. Mr Thomſon of Duddingſton, which is repreſented in figures 1. and 2. of Plate CCCLXXXIX. In fig. 1. A is a metallic or wooden ring, in which the four wooden bars AF, AI, AG, AH, move by means of joints at A, and are kept aſunder by the croſs pieces BC, DE, which move round B and D as centres, and fold up along BA and DA, when the inſtrument is not uſed. The ſurface FIGH, on which the image is received, conſiſts of a piece of ſilk covered with paper. It is made to roll up at IH, which moves in a joint at I, ſo that the whole ſurface FIHG, when winded upon IH, can be folded upon the bar IA. By this means the inſtrument, which is covered with green ſilk covered with a black ſubſtance, may be put together and carried as an umbrella. It is ſhewn more fully in fig. 2. where A is the aperture for placing the lens, and BC a ſemicircular opening for viewing the image. A black veil may be fixed to the circumference of BC, and thrown over the head of the obſerver to prevent the admiſſion of any extraneous light."

Plate CCCLXXXIX. Fig. 1, 2.

SECT. IV. *Microſcopes.*

UNDER the article MICROSCOPE a full account has been given of the external conſtruction of thoſe inſtruments as they are now made by the moſt eminent artiſts.

It did not fall within the plan of that article to explain the way in which an enlarged picture of the object is formed upon the retina by means of the microſcope, and the means of aſcertaining its magnifying power; but we ſhall now direct the readers attention to this intereſting ſubject.

1. *The Single Microſcope*, the ſimpleſt of all microſcopes, is nothing more than a ſmall globule of glaſs, or a convex lens whoſe focal diſtance is extremely ſhort. The magnifying power of this microſcope is thus aſcertained by Dr Smith. "A minute object pq, ſeen diſtinctly through a ſmall glaſs AE by the eye put cloſe to it, appears ſo much greater than it would to the naked eye, placed at the leaſt diſtance qL from whence it appears ſufficiently diſtinct, as this latter diſtance qL is greater than the former qE. For having put your eye cloſe to the glaſs EA, in order to ſee as much of the object as poſſible at one view, remove the object pq to and fro till it appear moſt diſtinctly, ſuppoſe at the diſtance Eq. Then conceiving the glaſs AE to be removed, and a thin plate, with a pin-hole in it, to be put in its place, the object will appear diſtinct and as large as before, when ſeen through the glaſs, only not ſo bright. And in this latter caſe it appears ſo much greater than it does to the naked eye at the diſtance qL, either with a pin-hole or without it, as the angle pEq is greater than the angle pLq, or as the latter diſtance qL is greater than the former qE. Since the interpoſition of the glaſs has no other effect than to render the appearance diſtinct, by helping the eye to increaſe the refraction of the rays in each pencil, it is plain that the greater apparent magnitude is entirely owing to a nearer view than could be taken by the naked eye. As the human eye is ſo conſtructed, as, for reaſons already aſſigned, to have diſtinct viſion only when the rays which fall upon it are parallel or nearly ſo; it follows that if the eye be ſo perfect as to ſee diſtinctly by pencils of parallel rays falling upon it, the diſtance Eq, of the object from the glaſs, is then the focal diſtance of the glaſs. Now, if the glaſs be a ſmall round globule, of about $\frac{1}{15}$th of an inch diameter, its focal diſtance Eq, being three quarters of its diameter, is $\frac{1}{20}$th of an inch; and if qL be eight inches, the diſtance at which we uſually view minute objects, this globule will magnify in the proportion of 8 to $\frac{1}{20}$, or of 160 to 1.

Plate CCLXXXVII. figs. 6, 7.

Mr Gray's *Water Microſcope* is repreſented in Plate CCCLXXXIX. fig. 4. The drop of water taken up on the point of a pin is introduced into the ſmall hole D, $\frac{1}{30}$ of an inch in diameter, in the piece of braſs DE, about $\frac{1}{16}$ of an inch thick. The hole D is in the middle of a ſpherical cavity, about $\frac{1}{8}$ of an inch in diameter, and a little deeper than half the thickneſs of the braſs; on the oppoſite ſide of the braſs is another ſpherical cavity, half as broad as the former, and ſo deep as to reduce the circumference of the ſmall hole to a ſharp edge. The water being placed in theſe cavities, will form a double convex lens with unequal convexities. The object, if it is ſolid, is fixed upon the point C of the ſupporter AB, and placed at its proper diſtance from the water lens by the ſcrew FG. When the object is fluid, it is placed in the hole A, but in ſuch a manner as not to be ſpherical; and this hole is brought oppoſite the fluid lens by moving the extremity G of the ſcrew into the ſlit GH.

2. *The Double or Compound Microſcope*, conſiſts of an object-glaſs cd, and an eye-glaſs ef. The ſmall object ab is placed at a little greater diſtance from the glaſs cd than its principal focus; ſo that the pencils of rays flowing from the different points of the object, and paſſing through the glaſs, may be made to converge, and unite in as many points between g and h, where the image of the object will be formed; which image is viewed by the eye through the eye-glaſs ef. For the eye-glaſs being ſo placed, that the image gh may be in its focus, and the eye much about the ſame diſtance on the other ſide, the rays of each pencil will be parallel after going out of the eye-glaſs, as at e and f, till they come to the eye at k, where they will begin to converge by the refractive power of the humours; and af- Fig. 8.

ter

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ter having croſſed each other in the pupil, they will be collected into points on the retina, and form upon it the large inverted image AB.

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Uſe of ſeveral lenſes in a compound microſcope.

By this combination of lenſes, the aberration of the light from the figure of the glaſs, which in a globule of the kind above-mentioned is very conſiderable, is in ſome meaſure corrected. This appeared ſo ſenſibly to be the caſe, even to former opticians, that they very ſoon began to make the addition of another lens. For, ſays Mr Martin, it is not only evident from the theory of this aberration, that the image of any point is rendered leſs confuſed by refraction through two lenſes than by an equal refraction through one; but it alſo follows, from the ſame principle, that the ſame point has its image ſtill leſs confuſed when formed by rays refracted through three lenſes than by an equal refraction through two; and therefore a third lens added to the other will contribute to make the image more diſtinct, and conſequently the inſtrument more complete. At the ſame time the field of view is amplified, and the uſe of the microſcope rendered more agreeable, by the addition of the other lens. Thus alſo we may allow a ſomewhat larger aperture to the object lens, and thus increaſe the brightneſs of objects, and greatly heighten the pleaſure of viewing them. For the ſame reaſon, Mr Martin has propoſed a four-glaſs microſcope, which anſwers the purpoſes of magnifying and of diſtinct viſion ſtill more perfectly.

Fig. 9.

The magnifying power of double microſcopes is eaſily underſtood, thus: The glaſs L next the object PQ is very ſmall, and very much convex, and conſequently its focal diſtance LF is very ſhort; the diſtance LQ of the ſmall object PQ is but a little greater than LF: Greater it muſt be, that the rays flowing from the object may converge after paſſing through the glaſs, and croſſing one another, form an image of the object; and it muſt be but a little greater, that the image pq may be at a great diſtance from the glaſs, and conſequently may be much larger than the object itſelf. This picture pq being viewed through a convex glaſs AE, whoſe focal diſtance is qE, appears diſtinct as in a teleſcope. Now the object appears magnified for two reaſons; firſt, becauſe, if we viewed its picture pq with the naked eye, it would appear as much greater than the object, at the ſame diſtance, as it really is greater than the object, or as much as Lq is greater than LQ; and ſecondly, becauſe this picture appears magnified through the eye-glaſs as much as the leaſt diſtance at which it can be ſeen diſtinctly with the naked eye, is greater than qE, the focal diſtance of the eye-glaſs. If this latter ratio be five to one, and the former ratio of Lq to LQ be 20 to 1; then, upon both accounts, the object will appear 5 times 20, or 100 times greater than to the naked eye.

Fig. 10.

The ſection of a compound microſcope with three lenſes is repreſented in fig. 10. By the middle one GK the pencil of rays coming from the object-glaſs are refracted ſo as to tend to a focus at O; but being intercepted by the proper eye-glaſs DF, they are brought together at I, which is nearer to that lens than its proper focus at L; ſo that the angle DIF, under which the object now appears, is larger than DLF, under which it would have appeared without this additional glaſs; and conſequently the object is more magnified in the ſame proportion. Dr Hooke informs us, that, in moſt of his obſervations, he made uſe of a double microſcope with this broad middle glaſs when he wanted to ſee much of an object at one view, and taking it out when he would examine the ſmall parts of an object more accurately; for the fewer refractions there are, the more bright and clear the object appears.

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Magnifying power of compound microſcopes with three lenſes.

The following rule for finding the magnifying power of compound microſcopes with three lenſes, has been given by Dr Brewſter in his Appendix to Ferguſon's Lectures, vol. ii. p. 468. "Divide the difference between the diſtance of the two firſt lenſes, or thoſe next the object, and the focal diſtance of the ſecond or amplifying glaſs, by the focal diſtance of the ſecond glaſs, and the quotient will be a firſt number. Square the diſtance between the two firſt lenſes, and divide it by the difference between that diſtance, and the focal diſtance of the ſecond glaſs, and divide this quotient by the focal diſtance of the third glaſs, or that next the eye, and a ſecond number will be obtained. Multiply together the *firſt* and *ſecond* numbers, and the magnifying power of the object glaſs, (as found by one of the following tables), and the product will be the magnifying power of the compound microſcope."

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The magnifying power of Dr Smith's microſcope.

Having in the hiſtorical part of this article given a ſhort account of the conſtruction of Dr Smith's double reflecting microſcope, it may not be improper in this place to point out the method of aſcertaining its magnifying power. This we ſhall do from the author himſelf, becauſe his ſymbols, being general, are applicable to ſuch microſcopes of all dimenſions.

Fig. 11.

Between the centre E and principal focus T of a concave ſpeculum ABC, whoſe axis is EQTC, place an object PQ; and let the rays flowing from it be reflected from the ſpeculum AB towards an image pq; but before they unite in it, let them be received by a convex ſpeculum abc, and thence be reflected, through a hole BC in the vertex of the concave, to a ſecond image $\pi\kappa$, to be viewed through an eye-glaſs l.

The object may be ſituated between the ſpecula C, c; or, which is better, between the principal focus t and vertex c of the convex one, a ſmall hole being made in its vertex for the incident rays to paſs through.

In both caſes we have TQ, TE, Tq, continual proportionals in ſome given ratio, ſuppoſe of 1 to n; and alſo tq, tc, $t\kappa$, continual proportionals in ſome other given ratio, ſuppoſe of 1 to m. Then if d be the uſual diſtance at which we view minute objects diſtinctly with the naked eye, and κl the focal diſtance of the leaſt eye-glaſs, through which the object appears ſufficiently bright and diſtinct, it will be magnified in the ratio of mnd to κl.

For the object PQ, and its firſt image pq, are terminated on one ſide by the common axis of the ſpecula, and on the other by a line PEp, drawn through the centre E of the concave ABC. Likewiſe the images pq and $\pi\kappa$ are terminated by the common axis and by the line $ep\pi$, drawn through the centre e of the convex abc, (Euclid, v. 12.). Hence, by the ſimilar triangles $\pi\kappa e$, pqe, and alſo pqE, PQE, we have $\pi\kappa : pq = \kappa e : qe = m : 1$, and $pq : \text{PQ} = q\text{E} : \text{QE} = n : 1$; and conſequently $\pi\kappa : \text{PQ} = mn : 1$, whence $\pi\kappa = mn \times \text{PQ}$. Now if $l\kappa$ be the focal diſtance of the eye-glaſs l, the points P, Q of the object, are ſeen through it by the rays of two pencils emerging parallel to the lines

πl κl-

$\pi\,l\,\varkappa\,l$ respectively; that is, PQ appears under an angle equal to $\pi\,l\,\varkappa$, which is as $\frac{\pi\,\varkappa}{\varkappa\,l}=\frac{m\,n\,PQ}{\varkappa\,l}$; and to the naked eye at the diſtance d from PQ, it appears under an angle P o Q which is as $\frac{PQ}{d}$, and therefore is magnified in the ratio of theſe angles, that is, of $m\,n\,d$ to $\varkappa\,l$.

COR. Having the numbers m, n, d, to find an eye-glaſs which ſhall cauſe the microſcope to magnify M times in diameter, take $\varkappa\,l=\frac{m\,n\,d}{M}$. For the apparent magnitude is to the true as $M : 1 = m\,n\,d : \varkappa\,l$.

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An eaſy method of aſcertaining the magnifying power of the moſt common microſcopes.

We ſhall conclude this part of our ſubject with the following eaſy method of aſcertaining the magnifying power of ſuch microſcopes as are moſt in uſe.

The apparent magnitude of any object, as muſt appear from what has been already ſaid, is meaſured by the angle under which it is ſeen; and this angle is greater or ſmaller according as the object is nearer to or farther from the eye; and of conſequence the leſs the diſtance at which it can be viewed, the larger it will appear. The naked eye is unable to diſtinguiſh any object brought exceedingly near it: but by looking through a convex lens at an object placed in its focus, however near the focus of that lens be, an object may be diſtinctly ſeen; and the ſmaller the lens is, the nearer will be its focus, and in the ſame proportion the greater will be its magnifying power. From theſe principles it is eaſy to find the reaſon why the firſt or greateſt magnifiers are ſo extremely minute; and alſo to calculate the magnifying power of any convex lens employed in a ſingle microſcope: For as the focal diſtance of the lens is to the diſtance at which we ſee objects diſtinctly with the naked eye, ſo is 1 to the magnifying power. If the focal length of a convex lens, for inſtance, be one inch, and the diſtance at which we look at ſmall objects eight inches, which is the common ſtandard, an object may be ſeen through that lens at one inch diſtance from the eye, and will appear in its diameter eight times larger than it does to the naked eye; but as the object is magnified every way, in length as well as in breadth, we muſt ſquare this diameter to know how much it really is enlarged; and we then find that its ſuperficies is magnified 64 times.

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Further obſervations on the magnifying power of microſcopes.

Again, Suppoſe a convex lens whoſe focal diſtance is only one-tenth of an inch; as in eight inches, the common diſtance of diſtinct viſion with the naked eye, there are 80 tenths, an object may be ſeen through this glaſs 80 times nearer than with the naked eye. It will, of conſequence, appear 80 times longer, and as much broader, than it does to common ſight; and is therefore magnified 6400 times. If a convex glaſs be ſo ſmall that its focus is only $\frac{1}{20}$th of an inch diſtant, we find that eight inches contain 160 of theſe twentieth parts; and conſequently the length and breadth of any object ſeen through ſuch a lens will be magnified 160 times, and the whole ſurface 25,600 times. As it is eaſy to melt a drop or globule of a much ſmaller diameter than a lens can be ground, and as the focus of a globule is no farther off than one-fourth of its own diameter, it muſt therefore magnify to a prodigious degree. But this exceſſive magnifying power is much more than counterbalanced by its admitting ſo little light, want of diſtinctneſs, and ſhowing ſuch a ſmall portion of the object to be examined; for which reaſon, theſe globules, though greatly valued ſome time ago, are now almoſt entirely rejected. According to Mr Folkes's deſcription of the ſingle microſcopes of convex lenſes which Leeuwenhock left to the Royal Society, they were all exceedingly clear, and ſhowed the object very bright and diſtinct; which Mr Folkes conſidered as owing to to the great care this gentleman took in the choice of his glaſs, his exactneſs in giving it the true figure, and afterwards reſerving only ſuch for his uſe as upon trial he found to be moſt excellent. Their powers of magnifying are different, as different objects may require: and as on the one hand, being all ground glaſſes, none of them are ſo ſmall, or conſequently magnify to ſo great a degree, as ſome of the globules frequently uſed in other microſcopes; yet the diſtinctneſs of theſe very much exceeds thoſe which are commonly uſed.

In order to find the magnifying power of a ſingle microſcope, no more is neceſſary than to bring it to its true focus, the exact place of which will be known by an object's appearing perfectly diſtinct and ſharp when placed there. Then, with a pair of ſmall compaſſes, meaſure, as nearly as poſſible, the diſtance from the centre of the glaſs to the object which is viewed, and how many parts of an inch that diſtance is. When this is known, compute how many times thoſe parts of an inch are contained in eight inches, and the reſult will give the number of times the diameter is magnified: ſquaring the diameter will give the ſuperficies; and if the ſolid content is wanted, it will be ſhown by multiplying the ſuperficies by the diameter.

The ſuperficies of one ſide of an object only can be ſeen at one view; and to compute how much that is magnified, is moſt commonly ſufficient: but ſometimes it is ſatisfactory to know how many minute objects are contained in a larger; as ſuppoſe we deſire to know how many animalcules are contained in the bulk of a grain of ſand: and to anſwer this, the cube, as well as the ſurface, muſt be taken into the account. For the ſatisfaction of thoſe who are not much verſant in theſe ſubjects, we ſhall here ſubjoin the following tables taken from the Appendix to Ferguſon's Lectures. 247

Tables of the magnifying power of microſcopes.

The firſt column contains the focal length of the convex lens in hundredths of an inch. The ſecond contains the number of times which ſuch a lens will magnify the diameter of objects: The third ſhews the number of times that the ſurface is magnified; and the fourth the number of times that the cube of the object is magnified. A table of a ſimilar kind, though upon a much ſmaller ſcale, has already been publiſhed; but the neareſt diſtance at which the eye can ſee diſtinctly, is there ſuppoſed to be *eight* inches, which we are confident from experience, is too large an eſtimate for the generality of eyes. Table I. is therefore computed upon the ſuppoſition that the diſtance alluded to is *ſeven* inches.

"When we conſider however (ſays the editor of the work now quoted) that the eye examines very minute objects at a leſs diſtance than it does objects of a greater magnitude, we ſhall find that the magnifying power of lenſes ought to be deduced from the *diſtance at which the eye examines objects really microſcopic.* This circumſtance has been overlooked by every writer on optics, and merits our attentive conſideration. We have now before us two ſpecimens of engraven characters.

racters. The one is so large that it can be easily read at the distance of ten inches; and the other is so exceedingly minute that it cannot be read at a greater distance than five inches. Now we maintain that if these two kinds of engraving are seen through the *same microscope*, the one will be *twice* as much magnified as the other. This indeed is obvious; for as the magnifying power of a lens is equal to the distance at which the object is examined by the naked eye divided by the focal length of the lens, we shall have $\frac{5}{x}$ for the number of times which the minute engraving is magnified, and $\frac{10}{x}$ for the number of times that the large engraving is magnified, x being the focal length of the lens. It follows, therefore, that the number of times that any lens magnifies objects really microscopic should be determined, by making the distance at which they are examined by the naked eye about five inches.

Upon this principle we have computed Table II. which contains the magnifying power of convex lenses when employed to examine microscopic objects.

Table I.

A New Table of the magnifying power of small convex lenses or single microscopes, the distance at which the eye sees distinctly being seven inches.

Focal distance of the lens or microscope.		Number of times that the *diameter* of an object is magnified.	Number of times that the *surface* of an object is magnified.	Number of times that the *cube* of an object is magnified.
Inches and parts of an inch.	100dths of an inch.	Dec. Times. of a time.	Times.	Times.
1 or	100	7.00	49	343
$\frac{3}{4}$ or	75	9.33	87	810
$\frac{1}{2}$ or	50	14.00	196	2744
$\frac{2}{5}$ or	40	17.50	306	5360
$\frac{3}{10}$ or	30	23.33	544	12698
$\frac{2}{10}$ or	20	35.00	1225	42875
	19	36.84	1354	49836
	18	38.89	1513	58864
	17	41.18	1697	69935
	16	43.75	1910	83453
	15	46.66	2181	101848
	14	50.00	2500	125000
	13	53.85	2894	155721
	12	58.33	3399	198156
	11	63.67	4045	257259
$\frac{1}{10}$ or	10	70.00	4900	343000
	9	77.78	6053	470911
	8	87.50	7656	669922
	7	100.00	10000	1000000
	6	116.66	13689	1601613
$\frac{1}{20}$ or	5	140.00	19600	2744000
$\frac{1}{25}$ or	4	175.00	30625	5359375
	3	233.33	54289	12649337
$\frac{1}{50}$ or	2	350.00	122500	42875000
	1	700.00	490000	343000000

Table II.

A New Table of the magnifying power of small convex lenses or single microscopes, the distance at which the eye sees distinctly being five inches.

Focal distance of the lens or microscope.		Number of times that the *diameter* of an object is magnified.	Number of times that the *surface* of an object is magnified.	Number of times that the *cube* of an object is magnified.
Inches and parts of an inch.	100dths of an inch.	Dec. Times. of a time.	Times.	Times.
1 or	100	5.00	25	125
	75	6.67	44	297
	50	10.00	100	1000
	40	12.50	156	1953
	30	16.67	278	4632
	20	25.00	625	15625
	19	26.32	693	18233
	18	27.78	772	21439
	17	29.41	865	25438
	16	31.25	977	30518
	15	33.33	1111	37026
	14	35.71	1275	45538
	13	38.48	1481	56978
	12	41.67	1736	72355
	11	45.55	2075	94507
	10	50.00	2500	125000
	9	55.55	3086	171416
	8	62.50	3906	244141
	7	71.43	5102	364453
	6	83.33	6944	578634
	5	100.00	10000	1000000
	4	125.00	15625	1953125
	3	166.67	27779	4629907
	2	250.00	62500	15625000
	1	500.00	250000	125000000

The greatest magnifier in Mr Leeuwenhoek's cabinet of microscopes, presented to the Royal Society, has its focus nearly at one-twentieth of an inch distance from its centre; and consequently magnifies the diameter of an object 160 times, and the superficies 25,600. But the greatest magnifier in Mr Wilson's single microscopes, as they are now made, has usually a focal length only of the 50th part of an inch; whereby it has a power of enlarging the diameter of an object 400, and its superficies 160,000 times.

248 The magnifying power of the solar microscope calculated differently from that of others.

The magnifying power of the solar microscope must be calculated in a different manner; for here the distance of the screen or sheet on which the image of the object is cast, divided by the focal length of the lens, gives its magnifying power. Suppose, for instance, the lens made use of has its focus at half an inch, and the screen is placed at the distance of five feet, the object will then appear magnified 20 times, and the superficies 14,400 times; and, by putting the screen at a greater distance, you may magnify the object almost as much as you please: but the screen should be placed just at that distance where the object is seen most distinct and clear.

With regard to the double reflecting microſcope, Mr Baker obſerves, that the power of the object-lens is indeed greatly increaſed by the addition of two eye-glaſſes; but as no object-lens can be uſed with them of ſo minute a diameter, or which magnifies of itſelf near ſo much as thoſe that can be uſed alone, the glaſſes of this microſcope, upon the whole, magnify little or nothing more than thoſe of Mr Wilſon's ſingle one; the chief advantage ariſing from a combination of lenſes being the ſight of a larger portion of the object.

Sect. V. *Teleſcopes.*

I. The Refracting Telescope.

249 Of the aſtronomical teleſcope.

1. *The Aſtronomical Teleſcope.*—From what has been ſaid concerning the compound microſcope, the nature of the common aſtronomical teleſcope will eaſily be underſtood: for it differs from the microſcope only in this, that the object is placed at ſo great a diſtance from it, that the rays of the ſame pencil, flowing from the object, may be conſidered as falling parallel upon the object-glaſs; and therefore the image made by that lens is conſidered as coincident with its focus of parallel rays.

Plate CCCLXXXVII. Fig. 12.

1. This will appear very plain from fig. 4. in which AB is the object emitting the ſeveral pencils of rays A *c d*, B *c d*, &c. but ſuppoſed to be at ſo great a diſtance from the object-glaſs, *c d*, that the rays of the ſame pencil may be conſidered as parallel to each other; they are therefore ſuppoſed to be collected into their reſpective foci at the points *m* and *p*, ſituated at the focal diſtance of the object-glaſs *c d*. Here they form an image E, and croſſing each other proceed diverging to the eye-glaſs *h g*; which being placed at its own focal diſtance from the points *m* and *p*, the rays of each pencil, after paſſing through that glaſs, will become parallel among themſelves; but the pencils themſelves will converge conſiderably with reſpect to one another, even ſo as to croſs at *e*, very little farther from the glaſs *g h* than its focus; becauſe, when they entered the glaſs, their axes were almoſt parallel, as coming through the object-glaſs at the point *k*, to whoſe diſtance the breadth of the eye-glaſs in a long teleſcope bears very ſmall proportion. So that the place of the eye will be nearly at the focal diſtance of the eye-glaſs, and the rays of each reſpective pencil being parallel among themſelves, and their axes croſſing each other in a larger angle than they would do if the object were to be ſeen by the naked eye, viſion will be diſtinct, and the object will appear magnified.

250 Its magnifying power.

The magnifying power in this teleſcope is as the focal length of the object-glaſs to the focal length of the eye-glaſs.

In order to prove this, we may conſider the angle A *k* B as that under which the object would be ſeen by the naked eye; for in conſidering the diſtance of the object, the length of the teleſcope may be omitted, as bearing no proportion to it. Now the angle under which the object is ſeen by means of the teleſcope is *g e h*, which is to the other A *k* B, or its equal *g k h*, as the diſtance from the centre of the object-glaſs to that of the eye-glaſs. The angle, therefore, which an object ſubtends to an eye aſſiſted by a teleſcope of this kind, is to that under which it ſubtends to the naked eye, as the focal length of the object-glaſs to the focal length of the eye-glaſs.

It is evident from the figure, that the viſible area, or ſpace which can be ſeen at one view, when we look through this teleſcope, depends on the breadth of the eye-glaſs, and not of the object-glaſs; for if the eye-glaſs be too ſmall to receive the rays *g m*, *p h*, the extremities of the object could not have been ſeen at all: a larger breadth of the object-glaſs conduces only to the rendering each point of the image more luminous, by receiving a larger pencil of rays from each point of the object.

251 Objects ſeen through it inverted.

It is in this teleſcope as in the compound microſcope, where we ſee not the object itſelf, but only its image CED: now that image being inverted with reſpect to the object, becauſe the axis of the pencils that flow from the object croſs each other at *k*, objects ſeen through a teleſcope of this kind neceſſarily appear inverted.

Plate CCCLXXXVII. Fig. 13.

This is a circumſtance not at all regarded by aſtronomers: but for viewing objects upon the earth, it is convenient that the inſtrument ſhould repreſent them in their natural poſture; to which uſe the teleſcope with three eye-glaſſes, as repreſented fig. 13. is peculiarly adapted.

252 Common refracting teleſcope ſhows objects erect.

AB is the object ſending out the ſeveral pencils A *c d*, B *c d*, &c. which paſſing through the object-glaſs *c d*, are collected into their reſpective foci in CD, where they form an inverted image. From this they proceed to the firſt eye-glaſs *e f*, whoſe focus being at *l*, the rays of each pencil are rendered parallel among themſelves, and their axes, which were nearly parallel before, are made to converge and croſs each other: the ſecond eye-glaſs *g h*, being ſo placed that its focus ſhall fall upon *m*, renders the axes of the pencils which diverge from thence parallel, and cauſes the rays of each, which were parallel among themſelves, to meet again at its focus EF on the other ſide, where they form a ſecond image inverted with reſpect to the former, but erect with reſpect to the object. Now this image being ſeen by the eye at *a b* through the eye-glaſs *i k*, affords a direct repreſentation of the object, and under the ſame angle that the firſt image CD would have appeared, had the eye been placed at *l*, ſuppoſing the eye-glaſſes to be of equal convexity; and therefore the object is ſeen equally magnified in this as in the former teleſcope, that is, as the focal diſtance of the object-glaſs to that of any one of the eye-glaſſes, and appears erect.

253 Galilean teleſcope. Plate CCCLXXXVIII. Fig. 1.

2. *The Galilean Teleſcope* with the concave eye-glaſs is conſtructed as follows.

AB is an object ſending forth the pencils of rays *g h i*, *k l m*, &c. which, after paſſing through the object-glaſs *c d*, tend towards *e* E *f* (where we ſhall ſuppoſe the focus of it to be), in order to form an inverted image there as before; but in their way to it are made to paſs through the concave glaſs *n o*, ſo placed that its focus may fall upon E, and conſequently the rays of the ſeveral pencils which were converging towards thoſe reſpective focal points *e*, E, *f*, will be rendered parallel: but the axes of thoſe pencils croſſing each other at F, and diverging from thence, will be rendered more diverging, as repreſented in the figure. Now theſe rays entering the pupil of an eye, will form a large and diſtinct image *a b* upon the retina, which will be inverted with

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with respect to the object, because the axis of the pencils cross in F. The object of course will be seen erect, and the angle under which it will appear will be equal to that which the lines *a* F, *b* F, produced back through the eye-glass, form at F.

It is evident, that the less the pupil of the eye is, the less is the visible area seen through a telescope of this kind; for a less pupil would exclude such pencils as proceed from the extremities of the object AB, as is evident from the figure. This inconvenience renders this telescope unfit for many uses; and is only to be remedied by the telescope with the convex eye-glasses, where the rays which form the extreme parts of the image are brought together in order to enter the pupil of the eye, as explained above.

It is apparent also, that the nearer the eye is placed to the eye-glass of this telescope, the larger is the area seen through it; for, being placed close to the glass, as in the figure, it admits rays that come from A and B, the extremities of the object, which it could not if it was placed farther off.

254 Magnifying power of.

The degree of magnifying in this telescope is in the same proportion with that in the other, viz. as the focal distance of the object-glass is to the focal distance of the eye-glass.

For there is no other difference but this, viz. that as the extreme pencils in that telescope were made to converge and form the angle *g e h* or *i n k* (fig. 13.), these are now made to diverge and form the angle *a* F *b* (fig. 1.); which angles, if the concave glass in one has an equal refractive power with the convex one in the other, will be equal, and therefore each kind will exhibit the object magnified in the same degree.

Plate CCCLXXXVII. Plate CCCLXXXVIII

There is a defect in all these kinds of telescopes, not to be remedied in a single lens by any means whatever, which was thought only to arise from the spherical aberration of the object-glass. But it was discovered by Sir Isaac Newton, that the imperfection of this sort of telescope, so far as it arises from the spherical form of the glasses, bears little proportion to that which is owing to the different refrangibility of light. This diversity in the refraction of rays is about a 28th part of the whole; so that the object-glass of a telescope cannot collect the rays which flow from any one point in the object into less space than a circle whose diameter is about the 56th part of the breadth of the glass.

Plate CCCLXXXVIII Fig. 2.

To show this, let AB represent a convex lens, and let CDF be a pencil of rays flowing from the point D; let H be the point at which the least refrangible rays are collected to a focus; and I, that where the most refrangible concur. Then, if IH be the 28th part of EH, IK will be a proportionable part of EC (the triangles HIK and HEC being similar): consequently LK will be the 28th part of FC. But MN will be the least space into which the rays will be collected, as appears by their progress represented in the figure. Now MN is but about half of KL; and therefore it is about the 56th part of the breadth of that part of the glass through which the rays pass; which was to be shown.

Since therefore each point of the object will be represented in so large a space, and the centres of those spaces will be contiguous, because the points in the object the rays flow from are so; it is evident, that the image of an object made by such a glass must be a most confused representation, though it does not appear so when viewed through an eye-glass that magnifies in a moderate degree; consequently the degree of magnifying in the eye-glass must not be too great with respect to that of the object-glass, lest the confusion become sensible.

Notwithstanding this imperfection, a dioptrical telescope may be made to magnify in any given degree, provided it be of sufficient length; for the greater the focal distance of the object-glass is, the less may be the proportion which the focal distance of the eye-glass may bear to that of the object-glass, without rendering the image obscure. Thus, an object-glass, whose focal distance is about four feet, will admit of an eye-glass whose focal distance shall be little more than an inch, and consequently will magnify almost 48 times; but an object-glass of 40 feet focus will admit of an eye-glass of only four inches focus, and will therefore magnify 120 times; and an object-glass of 100 feet focus will admit of an eye-glass of little more than six inches focus, and will therefore magnify almost 200 times.

255 Refracting telescopes magnify in proportion to their length.

The reason of this disproportion in their several degrees of magnifying may be explained thus: Since the diameter of the spaces, into which rays flowing from the several points of an object are collected, are as the breadth of the object-glass, it is evident that the degree of confusedness in the image is as the breadth of that glass; for the degree of confusedness will only be as the diameters or breadths of those spaces, and not as the spaces themselves. Now the focal length of the eye-glass, that is, its power of magnifying, must be as that degree; for, if it exceeds it, it will render the confusedness sensible; and therefore it must be as the breadth or diameter of the object-glass. The diameter of the object-glass, which is as the square root of its aperture or magnitude, must be as the square root of the power of magnifying in the telescope; for unless the aperture itself be as the power of magnifying, the image will want light: the square root of the power of magnifying will be as the square root of the focal distance of the object-glass; and therefore the focal distance of the eye-glass must be only as the square root of that of the object-glass. So that in making use of an object-glass of a longer focus, suppose, than one that is given, you are not obliged to apply an eye-glass of a proportionably longer focus than what would suit the given object-glass, but such a one only whose focal distance shall be to the focal distance of that which will suit the given object-glass, as the square root of the focal length of the object-glass you make use of, is to the square root of the focal length of the given one. And this is the reason that longer telescopes are capable of magnifying in a greater degree than shorter ones, without rendering the object confused or coloured.

Upon these principles the following new table, taken from the Appendix to Ferguson's Lectures, vol. ii. p. 471. second edition, has been computed. It is founded on a telescope of Huygens, mentioned in his *Astroscopia Compendiaria*, which had an object-glass 34 feet in focal length, and which bore an eye-glass of $2\frac{1}{4}$ inches focal distance, and therefore magnified 163 times. The table for refracting telescopes, which has been given by preceding optical writers, was copied from Smith's Optics,

tics, as the production of the celebrated Huygens, while it was calculated only by the editors of his Dioptrics, from a telescope made by that celebrated optician; which, however, seems to have been inferior to that which is the foundation of the following table. The table is suited to Rhinland measure; but the second and third columns may be converted into English measure by dividing them by .7, the focal distances of the object-glasses being supposed English feet.

A New Table of the apertures, focal lengths, and magnifying power of refracting telescopes.

Focal length of the object-glass.	Sine or aperture of the eye-glass.	Focal distance of the eye-glass.	Magnifying power.
Feet.	Inch. Dec.	Inch. Dec.	Times.
1	0.65	0.50	28
2	1.03	0.62	39
3	1.30	0.75	48
4	1.45	0.87	55
5	1.61	1.00	60
6	1.79	1.07	67
7	1.96	1.15	73
8	2.14	1.21	77
9	2.20	1.30	83
10	2.32	1.38	87
13	2.63	1.58	99
15	2.81	1.70	106
20	3.31	1.95	123
25	3.73	2.15	139
30	4.01	2.40	150
35	4.34	2.58	163
40	4.64	2.76	174
45	4.92	2.93	184
50	5.20	3.08	195
55	5.48	3.22	205
60	5.71	3.36	214
70	6.16	3.64	231
80	6.58	3.90	246
90	7.02	4.12	262
100	7.39	4.35	276
200	10.41	6.17	389
300	12.89	7.52	479
400	14.72	8.71	551
500	16.52	9.71	618

Sect. VI. *On Achromatic Telescopes.*

256
Their imperfections remedied by Dollond and Blair.

The inconveniency of very long telescopes is so great, that different attempts have been made to remove it. Of these, the most successful have been by Dollond and Blair; and the general principles upon which these eminent opticians proceeded have been mentioned in the historical part of this article, and in the preceding section. A fuller account of Dr Blair's discovery will be seen in the Transactions of the Royal Society of Edinbugh; and of Dollond's, it may be sufficient to observe, in addition to what has been already said, that the object-glasses of his telescopes are composed of three distinct lenses, two convex and one concave; of which the concave one is placed in middle, as is represented in fig. 3. where *a* and *c* show the two convex lenses, and *b b* the concave one, which is by the British artists placed in the middle. The two convex ones are made of London crown glass, and the middle one of white flint glass; and they are all ground to spheres of different radii, according to the refractive powers of the different kinds of glass and the intended focal distance of the object-glass of the telescope. According to Boscovich, the focal distance of the parallel rays for the concave lens is one-half, and for the convex glass one third of the combined focus. When put together, they refract the rays in the following manner. Let *a b*, *a b*, be two red rays of the sun's light falling parallel on the first convex lens *c*. Supposing there was no other lens present but that one, they would be converged into the lines *b e*, *b e*, and at last meet in the focus *q*. Let the lines *g h*, *g h*, represent two violet rays falling on the surface of the lens. These are also refracted, and will meet in a focus; but as they have a greater degree of refrangibility than the red rays, they must of consequence converge more by the same power of refraction in the glass, and meet sooner in a focus, suppose at *r*.—Let now the concave lens *d d* be placed in such a manner as to intercept all the rays before they come to their focus. Were this lens made of the same materials, and ground to the same radius with the convex one, it would have the same power to cause the rays diverge that the former had to make them converge. In this case, the red rays would become parallel, and move on in the line *o o*, *o o:* But the concave lens, being made of flint glass, and upon a shorter radius, has a greater refractive power, and therefore they diverge a little after they come out of it; and if no third lens was interposed, they would proceed diverging in the lines *o p t*, *o p t;* but, by the interposition of the third lens *o v o*, they are again made to converge, and meet in a focus somewhat more distant than the former, as at *x*. By the concave lens the violet rays are also refracted, and made to diverge: but having a greater degree of refrangibility, the same power of refraction makes them diverge somewhat more than the red ones; and thus, if no third lens was interposed, they would proceed in such lines as *l m n*, *l m n*. Now as the differently coloured rays fall upon the third lens with different degrees of divergence, it is plain, that the same power of refraction in that lens will operate upon them in such a manner as to bring them all together to a focus very nearly at the same point. The red rays, it is true, require the greatest power of refraction to bring them to a focus; but they fall upon the lens with the least degree of divergence. The violet rays, though they require the least power of refraction, yet have the greatest degree of divergence; and thus all meet together in the point *x*, or nearly so.

Fig. 3. Fig 4.

But, though we have hitherto supposed the refraction of the concave lens to be greater than that of the convex ones, it is easy to see how the errors occasioned by the first lens may be corrected by it, though it should have even a less power of refraction than the convex one. Thus, let *a b*, *a b*, be two rays of red light falling upon the convex lens *c*, and refracted into the focus *q;* let also *g h*, *g h*, be two violet rays converged into a focus at *r;* it is not necessary, in order to their convergence into a common focus at *x*, that the concave lens should make them *diverge:* it is sufficient if the glass has

Plate CCCLXXXVIII Fig. 5.

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has a power of difperfing the violet rays fomewhat more than the red ones; and many kinds have this power of difperfing fome kinds of rays, without a very great power of refraction. It is better, however, to have the object-glafs compofed of three lenfes; becaufe there is then another correction of the aberration by means of the third lens; and it might be impoffible to find two lenfes, the errors of which would exactly correct each other. It is alfo eafy to fee, that the effect may be the fame whether the concave glafs is a portion of the fame fphere with the others or not; the effect depending upon a combination of certain circumftances, of which there is an infinite variety.

By means of this correction of the errors arifing from the different refrangibility of the rays of light, it is poffible to fhorten refracting telefcopes confiderably, and yet leave them equal magnifying powers. The reafon of this is, that the errors arifing from the object-glafs being removed, thofe which are occafioned by the eye-glafs are inconfiderable: for the error is always in proportion to the length of the focus in any glafs; and in very long telefcopes it becomes exceedingly great, being no lefs than $\frac{1}{28}$th of the whole; but in glaffes of a few inches focus it becomes trifling. Refracting telefcopes, which go by the name of *Dollond's*, are therefore now conftructed in the following manner. Let AB reprefent an object-glafs compofed of three lenfes as above defcribed, and converging the rays 1, 2, 3, 4, &c. to a very diftant focus as at x. By means of the interpofed lens CD, however, they are converged to one much nearer, as at y, where an image of the object is formed. The rays diverging from thence fall upon another lens EF, where the pencils are rendered parallel, and an eye placed near that lens would fee the object magnified and very diftinct. To increafe the magnifying power ftill more, however, the pencils thus become parallel are made to fall upon another at GH; by which they are again made to converge to a diftant focus: but, being intercepted by the lens IK, they are made to meet at the nearer one z; whence diverging to LM, they are again rendered parallel, and the eye at N fees the object very diftinctly.

Fig. 6.

From an infpection of the figure it is evident, that Dollond's telefcope thus conftructed is two telefcopes combined together; the firft ending with the lens EF, and the fecond with LM. In the firft we do not perceive the object itfelf, but the image of it formed at y; and in the fecond we perceive only the image of that image formed at z. Such telefcopes are neverthelefs exceedingly diftinct, and reprefent objects fo clearly, as to be preferred, in viewing terreftrial things, even to reflectors. The latter indeed have greatly the advantage in their powers of magnifying, but they are much deficient in point of light. Much more light is loft by reflection than by refraction: and as in thefe telefcopes the light muft unavoidably fuffer two reflections, a great deal of it is loft; nor is this lofs counterbalanced by the greater aperture which thefe telefcopes will bear, which enables them to receive a greater quantity of light than the refracting ones. The metals of reflecting telefcopes alfo are very much fubject to tarnifh, and require much more dexterity to clean them than the glaffes of refractors; which makes them more troublefome and expenfive, though for making difcoveries in the heavens they are undoubtedly the only proper inftruments which have been hitherto conftructed.

II. The Reflecting Telescope.

257 Newtonian telefcope.

The inconveniences arifing from the great length of refracting telefcopes, before the difcovery of the achromatic telefcope, are fufficiently obvious; and thefe, together with the difficulties occafioned by the different refrangibility of light, induced Sir Ifaac Newton to turn his attention to the fubject of reflection, and endeavour to realize the ideas of himfelf and others concerning the poffibility of conftructing telefcopes upon that principle.—The inftrument which he contrived is reprefented, fig. 7. where ABCD is a large tube, open at AD and clofed at BC, and of a length at leaft equal to the diftance of the focus from the metallic fpherical concave fpeculum GH placed at the end BC. The rays EG, FH, &c. proceeding from a remote object PR, interfect one another fomewhere before they enter the tube, fo that EG, eg, are thofe that come from the lower part of the object, and fh, FH from its upper part: thefe rays after falling on the fpeculum GH, will be reflected, fo as to converge and meet in mn, where they will form a perfect image of the object.—But as this image cannot be feen by the fpectator, they are intercepted by a fmall plane metallic fpeculum KK, interfecting the axis at an angle of 45°, by which the rays tending to mn will be reflected towards a hole LL in the fide of the tube, and the image will be lefs diftinct, becaufe fome of the rays which would otherwife fall on the concave fpeculum GH, are intercepted by the plane fpeculum: neverthelefs it will appear in a confiderable degree diftinct, becaufe the aperture AD of the tube, and the fpeculum GH are large. In the lateral hole LL is fixed a convex lens, whofe focus is at Sq; and therefore this lens will refract the rays that proceed from any point of the image, fo as at their exit they will be parallel, and thofe that proceed from the extreme points Sq will converge after refraction, and form an angle at O, where the eye is placed; which will fee the image Sq, as if it were an object through the lens LL; confequently the object will appear enlarged, inverted, bright, and diftinct. In LL lenfes of different convexities may be placed, which by being moved nearer to the image or farther from it, would reprefent the object more or lefs magnified, provided that the furface of the fpeculum GH be of a perfectly fpherical figure. If, in the room of one lens LL, three lenfes be difpofed in the fame manner with the three eye-glaffes of the refracting telefcope, the object will appear erect, but lefs diftinct than when it is obferved with one lens.

Fig. 7.

258 New finder for Newtonian telefcope.

On account of the pofition of the eye in this telefcope, it is extremely difficult to direct the inftrument towards any object. Huygens, therefore, firft thought of adding to it a fmall refracting telefcope, the axis of which is parallel to that of the reflector. This is called a *finder* or *director*. When the Newtonian telefcope is large, and placed upon its lower end to view bodies in great altitudes, the common finder can be of no ufe, from the difficulty of getting the eye to the eye-piece. On this account Dr Brewfter propofes (Appendix to Fergufon's Lectures, vol. ii. p. 478.) to bend the tube of the finder to a right angle, and place a plane mirror at the angular point, fo as to throw the image above the upper part of the tube, that

that the eye-piece of the finder may be as near as possible to the eye-piece of the telescope. The angular part, where the plain mirror is to be fixed, should be placed as near as possible to the focal image, in order that only a small part of the finder may stand above the tube; and in this way the eye can be transferred with the greatest facility from the one eye-piece to the other. The advantages of this construction will be understood from fig. 3. Plate CCCLXXXIX. where TT is part of a Newtonian telescope, D the eye-piece, and ABC the finder. The image formed by the object-glass A is reflected upwards by the plain mirror B, placed at an angle of 45° with the axis of the tube, and the image is viewed with the eye-glass AC. Those who have been in the habit of using the Newtonian telescope with the common finder will be sensible of the convenience resulting from this contrivance.

Plate CCCLXXXIX. Fig. 3.

259 Magnifying power of Newtonian telescopes.

In order to determine the magnifying power of this telescope, it is to be considered that the plane speculum KK is of no use in this respect. Let us then suppose, that one ray proceeding from the object coincides with the axis GLIA of the lens and speculum; let bb be another ray proceeding from the lower extreme of the object, and passing through the focus I of the speculum KH: this will be reflected in the direction bid, parallel to the axis GLA, and falling on the lens d L d, will be refracted to G; so that GL will be equal to L l, and $d\text{G}=d\text{I}$. To the naked eye the object would appear under the angle $\text{I}bi=b\text{IA}$; but by means of the telescope it appears under the angle $d\text{GL}=d\text{IL}=\text{I}di$: and the angle I di is to the angle I bi : : I b : I d; consequently the apparent magnitude by the telescope is to that by the naked eye as the distance of the focus of the speculum from the speculum, to the distance of the focus of the lens from the lens.

Plate CCCLXXXVIII Fig. 8.

The following new table of the apertures and magnifying power of Newtonian telescopes is taken from the Appendix to Ferguson's Lectures, vol. ii. p. 480. It is founded on a Newtonian telescope constructed by Hadley, in which the focal length of the great speculum was three feet three inches, and the magnifying power 226. Its aperture varied from three and a half to four and a half inches, according to the want of brightness in the objects to be examined. The first column contains the focal length of the great speculum in feet, and the second its linear aperture in inches, and hundredths of an inch. The third and fourth columns contain Sir Isaac Newton's numbers, by means of which the apertures of any kind of reflecting telescopes may be easily computed. The fifth column contains the focal length of the eye-glasses in thousandths of an inch, and the sixth contains the magnifying power of the instrument.

A New Table of the apertures and magnifying power of Newtonian Telescopes.

Focal length of the concave speculum.	Aperture of the concave speculum.	Sir Isaac Newton's numbers.		Focal length of the eye-glass.	Magnifying power
Feet.	Inch. Dec	Aperture of the speculum	Focal length of the eye-glass.	Inch. Dec.	Times.
½	1.34	100	100	0.107	56
1	2.23	168	119	0.129	93
2	3.79	283	141	0.152	158
3	5.14	383	157	0.168	214
4	6.36	476	168	0.181	265
5	7.51	562	178	0.192	313
6	8.64	645	186	0.200	360
7	9.67			0.209	403
8	10.44	800	200	0.218	445
9	11.69			0.222	487
10	12.65	946	212	0.228	527
11	13.58			0.233	566
12	14.50	1084	221	0.238	604
13	15.41			0.243	642
14	16.25			0.248	677
15	17.11			0.252	713
16	17.98	1345	238	0.256	749
17	18.82			0.260	784
18	19.63			0.264	818
19	20.45			0.268	852
20	21.24	1591	251	0.271	885
21	22.06			0.274	919
22	22.85			0.277	952
23	23.62			0.280	984
24	24.41	1824	263	0.283	1017

260 Gregorian telescope. Plate CCCLXXXVIII Fig. 9.

Let TYYT be a brass tube, in which L $l d$ D is a metallic concave speculum, perforated in the middle at X; and EF a less concave mirror, so fixed by the arm or strong wire RT, which is moveable by means of a long screw on the outside of the tube, as to be moved nearer to or farther from the larger speculum L $l d$ D, its axis being kept in the same line with that of the great one. Let AB represent a very remote object from each part of which issue pencils of rays, e. g. $c\,d$, CD, from A the upper extreme of the object, and IL, $i\,l$, from the lower part B; the rays IL, CD, from the extremes crossing one another before they enter the tube. These rays falling upon the larger mirror LD, are reflected from it into the focus KH, where they form an inverted image of the object AB, as in the Newtonian telescope. From this image the rays, issuing as from an object, fall upon the small mirror EF, the centre of which is at e; so that after reflection they would meet in their foci at QQ, and there form an erect image. But since an eye at that place could see but a small part of an object, in order to bring rays from more distant parts of it into the pupil, they are intercepted by the plano-convex lens MN, by which means a smaller erect image is formed at PV, which is viewed from

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from the meniscus SS by an eye at O. This meniscus both makes the rays of each pencil parallel and magnifies the image PV. At the place of this image all the foreign rays are intercepted by the perforated partition ZZ. For the same reason the hole near the eye O is very narrow. When nearer objects are viewed by this telescope, the small speculum EF is removed to a greater distance from the larger LD, so that the second image may be always formed in PV; and this distance is to be adjusted (by means of the screw on the outside of the great tube) according to the form of the eye of the spectator. It is also necessary, that the axis of the telescope should pass through the middle of the speculum EF, and its centre, the centre of the speculum LL, and the middle of the hole X, the centres of the lenses MN, SS, and the hole near O. As the hole X in the speculum LL can reflect none of the rays issuing from the object, that part of the image which corresponds to the middle of the object must appear to the observer more dark and confused than the extreme parts of it. Besides, the speculum EF will also intercept many rays proceeding from the object; and therefore unless the aperture TT be large, the object must appear in some degree obscure.

In the best reflecting telescopes, the focus of the small mirror is never coincident with the focus of the great one, where the first image KH is formed, but a little beyond it (with respect to the eye), as at *n*; the consequence of which is, that the rays of the pencils will not be parallel after reflection from the small mirror, but converge so as to meet in points about Q *q* Q, where they would form a larger upright image than PV, if the glass R was not in their way; and this image might be viewed by means of a single eye-glass properly placed between the image and the eye; but then the field of view would be less, and consequently not so pleasant; for which reason, the glass R is still retained, to enlarge the scope or area of the field.

261 Its magnifying power.

To find the magnifying power of this telescope, multiply the focal distance of the great mirror by the distance of the small mirror from the image next the eye, and multiply the focal distance of the small mirror by the focal distance of the eye-glass: then divide the former product by the latter, and the quotient will express the magnifying power. For a table of the apertures and powers of Gregorian telescopes, see Appendix to Ferguson's Lectures, vol. ii. p. 472, 473.

One great advantage of the reflecting telescope is, that it will admit of an eye-glass of a much shorter focal distance than a refracting telescope; and consequently it will magnify so much the more: for the rays are not coloured by reflection from a concave mirror, if it be ground to a true figure, as they are by passing through a convex glass, let it be ground ever so true.

The nearer an object is to the telescope, the more its pencils of rays will diverge before they fall upon the great mirror, and therefore they will be the longer of meeting in points after reflection; so that the first image KH will be formed at a greater distance from the large mirror, when the object is near the telescope, than when it is very remote. But as this image must be formed farther from the small mirror than its principal focus *n*, this mirror must be always set at a greater distance from the larger one, in viewing near objects, than in viewing remote ones. And this is done by turning the screw on the outside of the tube, until the small mirror be so adjusted, that the object (or rather its image) appears perfect.

In looking through any telescope towards an object, we never see the object itself, but only that image of it which is formed next the eye in the telescope. For if a man holds his finger or a stick between his bare eye and an object, it will hide part (if not the whole) of the object from his view: But if he ties a stick across the mouth of a telescope before the object-glass, it will hide no part of the imaginary object he saw through the telescope before, unless it covers the whole mouth of the tube: for all the effect will be, to make the object appear dimmer, because it intercepts part of the rays. Whereas, if he puts only a piece of wire across the inside of the tube, between the eye-glass and his eye, it will hide part of the object which he thinks he sees; which proves, that he sees not the real object, but its image. This is also confirmed by means of the small mirror EF, in the reflecting telescope, which is made of opaque metal, and stands directly between the eye and the object towards which the telescope is turned; and will hide the whole object from the eye at O, if the two glasses ZZ and SS are taken out of the tube.

262 Cassegrainian telescope.

If the small mirror of the preceding instrument be convex instead of concave, it is then called the *Cassegrainian telescope*. As the small mirror is in this case placed between the great speculum and its focus, a Cassegrainian telescope will be shorter than a Gregorian one of the same magnifying power by twice the real length of the small mirror. For a table of the apertures, &c. of this instrument, see Appendix to Ferguson's Lectures, vol. ii. p. 474, 475.

SECT. VII. *On the Merits of different Microscopes and Telescopes.*

263 Merits of microscopes and telescopes compared.

THE advantages arising from the use of microscopes and telescopes depend, in the first place, upon their property of magnifying the minute parts of objects, so that they can by that means be more distinctly viewed by the eye; and, secondly, upon their throwing more light into the pupil of the eye than what is done without them. The advantages arising from the magnifying power would be extremely limited, if they were not also accompanied by the latter: for if the same quantity of light is spread over a large portion of surface, it becomes proportionably diminished in force; and therefore the objects, though magnified, appear proportionably dim. Thus, though any magnifying glass should enlarge the diameter of the object 10 times, and consequently magnify the surface 100 times, yet if the focal distance of the glass was about eight inches (provided this was possible), and its diameter only about the size of the pupil of the eye, the object would appear 100 times more dim when we looked through the glass, than when we beheld it with our naked eyes; and this, even on a supposition that the glass transmitted all the light which fell upon it, which no glass can do. But if the focal distance of the glass was only four inches, though its diameter remained as before, the inconvenience would be vastly diminished, because the glass could then

Merits of Microfcopes and Telefcopes compared.

then be placed twice as near the object as before, and consequently would receive four times as many rays as in the former cafe, and therefore we would fee it much brighter than before. Going on thus, ftill diminifhing the focal diftance of the glafs, and keeping its diameter as large as poffible, we will perceive the object more and more magnified, and at the fame time very diftinct and bright. It is evident, however, that with regard to optical inftruments of the microfcopic kind, we muft fooner or later arrive at a limit which cannot be paffed. This limit is formed by the following particulars. 1. The quantity of light loft in paffing through the glafs. 2. The diminution of the glafs itfelf, by which it receives only a fmall quantity of rays. 3. The extreme fhortnefs of the focal diftance of great magnifiers, whereby the free accefs of the light to the object which we wifh to view is impeded, and confequently the reflection of the light from it is weakened. 4. The aberrations of the rays, occafioned by their different refrangibility.

To underftand this more fully, as well as to fee how far thefe obftacles can be removed, let us fuppofe the lens made of fuch a dull kind of glafs that it tranfmits only one half of the light which falls upon it. It is evident that fuch a glafs, of four inches focal diftance, and which magnifies the diameter of an object twice, ftill fuppofing its own breadth equal to that of the pupil of the eye, will fhow it four times magnified in furface, but only half as bright as if it was feen by the naked eye at the ufual diftance; for the light which falls upon the eye from the object at eight inches diftance, and likewife the furface of the object in its natural fize, being both reprefented by 1, the furface of the magnified object will be 4, and the light which makes that magnified object vifible only 2: becaufe though the glafs receives four times as much light as the naked eye does at the ufual diftance of diftinct vifion, yet one half is loft in paffing through the glafs. The inconvenience in this refpect can therefore be removed only as far as it is poffible to increafe the clearnefs of the glafs, fo that it fhall tranfmit nearly all the rays which fall upon it; and how far this can be done, hath not yet been afcertained.

The fecond obftacle to the perfection of microfcopic glaffes is the fmall fize of great magnifiers, by which, notwithftanding their near approach to the object, they receive a fmaller quantity of rays than might be expected. Thus, fuppofe a glafs of only $\frac{1}{10}$th of an inch focal diftance; fuch a glafs would increafe the vifible diameter 80 times, and the furface 6400 times. If the breadth of the glafs could at the fame time be preferved as great as that of the pupil of the eye, which we fhall fuppofe $\frac{2}{10}$ths of an inch, the object would appear magnified 6400 times, at the fame time that every part of it would be as bright as it appears to the naked eye. But if we fuppofe that this magnifying glafs is only $\frac{1}{10}$th of an inch in diameter, it will then only receive $\frac{1}{4}$th of the light which otherwife would have fallen upon it; and therefore, inftead of communicating to the magnified object a quantity of illumination equal to 6400, it would communicate only one equal to 1600, and the magnified object would appear four times as dim as it does to the naked eye. This inconvenience, however, is ftill capable of being removed, not indeed by increafing the diameter of the lens, becaufe this muft be in proportion to its focal diftance, but by throwing a greater quantity of light on the object. Thus, in the above-mentioned example, if four times the quantity of light which naturally falls upon it could be thrown upon the object, it is plain that the reflection from it would be four times as great as in the natural way; and confequently the magnified image, at the fame time that it was as many times magnified as before, would be as bright as when feen by the naked eye. In tranfparent objects this can be done very effectually by a concave fpeculum, as in the reflecting microfcope already defcribed: but in opaque objects the cafe is fomewhat more doubtful; neither do the contrivances for viewing thefe objects feem entirely to make up for the deficiencies of the light from the fmallnefs of the lens and fhortnefs of the focus.—When a microfcopic lens magnifies the diameter of an object forty times, it hath then the utmoft poffible magnifying power, without diminifhing the natural brightnefs of the object.

The third obftacle arifes from the fhortnefs of the focal diftance in large magnifiers: but in tranfparent objects, where a fufficient quantity of light is thrown on the object from below, the inconvenience arifes at laft from ftraining the eye, which muft be placed nearer the glafs than it can well bear; and this entirely fuperfedes the ufe of magnifiers beyond a certain degree.

The fourth obftacle arifes from the different refrangibility of the rays of light, and which frequently caufes fuch a deviation from truth in the appearances of things that many people have imagined themfelves to have made furprifing difcoveries, and have even publifhed them to the world: when in fact they have been only as many optical deceptions, owing to the unequal refractions of the rays. For this there feems to be no remedy, except the introduction of achromatic glaffes into microfcopes as well as telefcopes. How far this is practicable, hath not yet been tried; but when thefe glaffes fhall be introduced (if fuch introduction is practicable,) microfcopes will then undoubtedly have received their ultimate degree of perfection.

264 Dollond's and Blair's refracting telefcopes fuperior to others.

With regard to telefcopes, thofe of the refracting kind have evidently the advantage of all others, where the aperture is equal, and the aberrations of the rays are corrected according to Mr Dollond's method; becaufe the image is not only more perfect, but a much greater quantity of light is tranfmitted than what can be reflected from the beft materials hitherto known. Unluckily, however, the imperfections of the glafs fet a limit to thefe telefcopes, as has been already obferved, fo that they cannot be made above three feet and a half long. On the whole, therefore, the reflecting telefcopes are preferable in this refpect, that they may be made of dimenfions greatly fuperior; by which means they can both magnify to a greater degree, and at the fame time throw much more light into the eye.

With regard to the powers of telefcopes, however, they are all of them exceedingly lefs than what we would be apt to imagine from the number of times which they magnify the object. Thus, when we hear of a telefcope which magnifies 200 times, we are apt to imagine, that, on looking at any diftant object through it, we fhould perceive it as diftinctly as we would with our naked eye at the 200th part of the

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the distance. But this is by no means the case; neither is there any theory capable of directing us in this matter: we must therefore depend entirely on experience.

The best method of trying the goodness of any telescope is to observe how much farther off you are able to read with it than with the naked eye. But that all deception may be avoided, it is proper to choose something to be read where the imagination cannot give any assistance, such as a table of logarithms, or something which consists entirely of figures; and hence the truly useful power of the telescope is easily known. In this way Mr Short's large telescope, which magnifies the diameter of objects 1200 times, is yet unable to afford sufficient light for reading at more than 200 times the distance at which we can read with our naked eye.

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The Gregorian telescope superior for common use to the Newtonian.

With regard to the form of reflecting telescopes, it is now pretty generally agreed, that when the Gregorian ones are well constructed, they have the advantage of those of the Newtonian form. One advantage evident at first sight is, that with the Gregorian telescope an object is perceived by looking directly through it, and consequently is found with much greater ease than in the Newtonian telescope, where we must look into the side. The unavoidable imperfection of the specula common to both, also gives the Gregorian an advantage over the Newtonian form. Notwithstanding the utmost care and labour of the workmen, it is found impossible to give the metals either a perfectly spherical or a perfectly parabolical form. Hence arises some indistinctness of the image formed by the great speculum, which is frequently corrected by the little one, provided they are properly matched. But if this is not done, the error will be made much worse; and hence many of the Gregorian telescopes are far inferior to the Newtonian ones; namely, when the specula have not been properly adapted to each other. There is no method by which the workman can know the specula which will fit one another without a trial; and therefore it is necessary to have many specula ready made of each sort, that in fitting up a telescope those may be chosen which best suit each other.

The brightness of any object seen through a telescope, in comparison with its brightness when seen by the naked eye, may in all cases be easily found by the following formula. Let n represent the natural distance at which an object can be distinctly seen; and let d represent its distance from the object-glass of the instrument. Let m be the magnifying power of the instrument; that is, let the visual angle subtended at the eye by the object when at the distance n, and viewed without the instrument, be to the visual angle produced by the instrument as 1 to m. Let a be the diameter of the object-glass, and p that of the pupil. Let the instrument be so constructed, that no parts of the pencils are intercepted for want of sufficient apertures of the intermediate glasses. Lastly, Let the light lost in reflection or refraction be neglected.

The brightness of vision through the instrument will be expressed by the fraction $\frac{\overline{an}^2}{mpd^2}$, the brightness of natural vision being 1. But although this fraction may exceed unity, the vision through the instrument will not be brighter than natural vision. For, when this is the case, the pupil does not receive all the light transmitted through the instrument.

In microscopes, n is the nearest limits of distinct vision, nearly *seven* inches. But a difference in this circumstance, arising from a difference in the eye, makes no change in the formula, because m changes in the same proportion with n.

In telescopes n and d may be reckoned equal, and the formula becomes $\frac{a^2}{mp^2}$.

Sect. VIII. *Apparatus for Measuring the Intensity of Light.*

266
M. Bouguer's contrivances for measuring light.

That some luminous bodies give a stronger, and others a weaker light, and that some reflect more light than others, was always known; but no person, before M. Bouguer, hit upon a tolerable method of ascertaining the proportion that two or more lights bear to one another. The methods he most commonly used were the following.

Plate CCCLXXXV. Fig. 4.

He took two pieces of wood or pasteboard EC and CD, in which he made two equal holes P and Q, over which he drew pieces of oiled or white paper. Upon these holes he contrived that the light of the different bodies he was comparing should fall; while he placed a third piece of pasteboard FC, so as to prevent the two lights from mixing with one another. Then placing himself sometimes on one side, and sometimes on the other, but generally on the opposite side of this instrument, with respect to the light, he altered their position till the papers in the two holes appeared to be equally enlightened. This being done, he computed the proportion of their light by the squares of the distances at which the luminous bodies were placed from the objects. If, for instance, the distances were as three and nine, he concluded that the lights they gave were as nine and eighty-one. Where any light was very faint, he sometimes made use of lenses, in order to condense it; and he enclosed them in tubes or not as his particular application of them required.

To measure the intensity of light proceeding from the heavenly bodies, or reflected from any part of the sky, he contrived an instrument which resembles a kind of portable camera obscura. He had two tubes, of which the inner was black, fastened at their lower extremities by a hinge C. At the bottom of these tubes were two holes, R and S, three or four lines in diameter, covered with two pieces of fine white paper. The two other extremities had each of them a circular aperture, an inch in diameter; and one of the tubes consisted of two, one of them sliding into the other, which produced the same effect as varying the aperture at the end. When this instrument is used, the observer has his head, and the end of the instrument C, so covered, that no light can fall upon his eye, besides that which comes through the two holes S and R, while an assistant manages the instrument, and draws out or shortens the tube DE, as the observer directs. When the two holes appear equally illuminated, the intensity of the lights is judged to be inversely as the squares of the tubes.

Fig. 5.

In using this instrument, it is necessary that the object should subtend an angle larger than the aperture A

or

Apparatus for Meaſuring Light.

or D, ſeen from the other end of the tube; for, otherwiſe, the lengthening of the tube has no effect. To avoid, in this caſe, making the inſtrument of an inconvenient length, or making the aperture D too narrow, he has recourſe to another expedient. He conſtructs an inſtrument, repreſented (fig. 6.), conſiſting of two object-glaſſes, AE and DF, exactly equal, fixed in the ends of two tubes ſix or ſeven feet, or, in ſome caſes, 10 or 12 feet long, and having their foci at the other ends. At the bottoms of theſe tubes B, are two holes, three or four lines in diameter, covered with a piece of white paper; and this inſtrument is uſed exactly like the former.

Fig. 6.

If the two objects to be obſerved by this inſtrument be not equally luminous, the light that iſſues from them muſt be reduced to an equality, by diminiſhing the aperture of one of the object-glaſſes; and then the remaining ſurface of the two glaſſes will give the proportion of their lights. But for this purpoſe, the central parts of the glaſs muſt be covered in the ſame proportion with the parts near the circumference, leaving the aperture ſuch as is repreſented (fig. 7.), becauſe the middle part of the glaſs is thicker and leſs tranſparent than the reſt.

Fig. 7.

If all the objects to be obſerved lie nearly in the ſame direction, Bouguer remarks, that theſe two long tubes may be reduced into one, the two object-glaſſes being placed cloſe together, and one eye-glaſs ſufficing for them both. The inſtrument will then be the ſame with that of which he publiſhed an account in 1748, and which he called a *heliometer*, or *aſtrometer*.

267 Theſe inſtruments meaſure only the intenſity of light.

It is not, however, the abſolute quantity, but only the intenſity of the light, that is meaſured by theſe two inſtruments, or the number of rays, in proportion to the ſurface of the luminous body; and it is of great importance that theſe two things be diſtinguiſhed. The intenſity of light may be very great, when the quantity, and its power of illuminating other bodies, may be very ſmall, on account of the ſmallneſs of its ſurface; or the contrary may be the caſe, when the ſurface is large.

Having explained theſe methods which M. Bouguer took to meaſure the different proportions of light, we ſhall ſubjoin a few examples of his application of them.

It is obſervable, that when a perſon ſtands in a place where there is a ſtrong light, he cannot diſtinguiſh objects that are placed in the ſhade; nor can he ſee any thing upon going immediately into a place where there is very little light. It is plain, therefore, that the action of a ſtrong light upon the eye, and alſo the impreſſion which it leaves upon it, makes it inſenſible to the effect of a weaker light. M. Bouguer had the curioſity to endeavour to aſcertain the proportion between the intenſities of the two lights in this caſe; and by throwing the light of two equal candles upon a board, he found that the ſhadow made by intercepting the light of one of them, could not be perceived by his eye, upon the place enlightened by the other, at little more than eight times the diſtance; from whence he concluded, that when one light is eight times eight, or 64 times leſs than another, its preſence or abſence will not be perceived. He allows, however, that the effect may be different on different eyes; and ſuppoſes that the boundaries in this caſe, with reſpect to different perſons, may lie between 60 and 80.

Applying the two tubes of his inſtrument, mentioned above, to meaſure the intenſity of the light reflected from different parts of the ſky; he found that when the ſun was 25 degrees high, the light was four times ſtronger at the diſtance of eight or nine degrees from his body, than it was at 31 or 32 degrees. But what ſtruck him the moſt was to find, that when the ſun is 15 or 20 degrees high, the light decreaſes on the ſame parallel to the horizon to 110 or 120 degrees, and then increaſes again to the place exactly oppoſite to the ſun.

The light of the ſun, our author obſerves, is too ſtrong, and that of the ſtars too weak, to determine the variation of their light at different altitudes: but as, in both caſes, it muſt be in the ſame proportion with the diminution of the light of the moon in the ſame circumſtances, he made his obſervations on that luminary, and found, that its light at 19° 16′, is to its light at 66° 11′, as 1681 to 2500; that is, the one is nearly two thirds of the other. He choſe thoſe particular altitudes, becauſe they are thoſe of the ſun at the two ſolſtices at Croiſic, where he then reſided. When one limb of the moon touched the horizon of the ſea, its light was 2000 times leſs than at the altitude of 66° 11′. But this proportion he acknowledges muſt be ſubject to many variations, the atmoſphere near the earth varying ſo much in its denſity. From this obſervation he concludes, that at a medium light is diminiſhed in the proportion of about 2500 to 1681, in traverſing 7469 toiſes of denſe air.

268 Great variation of the light of the moon at different altitudes.

269 Variation in different parts of the diſks of the ſun and planets.

M. Bouguer alſo applied his inſtrument to the different parts of the ſun's diſk, and found that the centre is conſiderably more luminous than the extremities of it. As near as he could make the obſervation, it was more luminous than a part of the diſk $\frac{1}{4}$ths of the ſemidiameter from it, in the proportion of 35 to 28; which, as he obſerves, is more than in the proportion of the ſines of the angles of obliquity. On the other hand, he obſerves, that both the primary and ſecondary planets are more luminous at their edges than near their centres.

The compariſon of the light of the ſun and moon is a ſubject that has frequently exerciſed the thoughts of philoſophers; but we find nothing but random conjectures, before Bouguer applied his accurate meaſures in this caſe. In general, the light of the moon is imagined to bear a much greater proportion to that of the ſun than it really does; and not only are the imaginations of the vulgar, but thoſe of philoſophers alſo, impoſed upon with reſpect to it. It was a great ſurpriſe to M. de la Hire to find that he could not, by the help of any burning mirror, collect the beams of the moon in a ſufficient quantity to produce the leaſt ſenſible heat. Other philoſophers have ſince made the like attempts with mirrors of greater power, though without any greater ſucceſs; but this will not ſurpriſe us, when we ſee the reſult of M. Bouguer's obſervations on this ſubject.

270 M. Bouguer's calculation concerning the light of the moon.

In order to ſolve this curious problem concerning the compariſon of the light of the ſun and moon, he compared each of them to that of a candle in a dark room, one in the day-time, and the other in the night following,

ing, when the moon was at her mean diſtance from the earth; and, after many trials, he concluded that the light of the ſun is about 300,000 times greater than that of the moon; which is ſuch a diſproportion, that, as he obſerves, it can be no wonder that philoſophers have had ſo little ſucceſs in their attempts to collect the light of the moon with burning glaſſes. For the largeſt of them will not increaſe the light 1000 times; which will ſtill leave the light of the moon, in the focus of the mirror, 300 times leſs than the intenſity of the common light of the ſun.

To this account of the proportion of light which we actually receive from the moon, it cannot be diſpleaſing to the reader, if we compare it with the quantity which would have been tranſmitted to us from that opaque body, if it reflected all the light it receives. Dr Smith thought that he had proved, from two different conſiderations, that the light of the full moon would be to our day-light as 1 to about 90,900, if no rays were loſt at the moon.

271 Dr Smith's calculation.

In the firſt place, he ſuppoſes that the moon enlightened by the ſun, is as luminous as the clouds are at a medium. He therefore ſuppoſed the light of the ſun to be equal to that of a whole hemiſphere of clouds, or as many moons as would cover the ſurface of the heavens. But on this Dr Prieſtley obſerves, that it is true, the light of the ſun ſhining perpendicularly upon any ſurface would be equal to the light reflected from the whole hemiſphere, if every part reflected all the light that fell upon it; but the light that would in fact be received from the whole hemiſphere (part of it being received obliquely) would be only one-half as much as would be received from the whole hemiſphere, if every part of it ſhone directly upon the ſurface to be illuminated.

In his Remarks, par. 97. Dr Smith demonſtrates his method of calculation in the following manner:

Plate CCCLXXXIV. Fig. 8.

"Let the little circle $cfdg$ repreſent the moon's body half enlightened by the ſun, and the great circle aeb, a ſpherical ſhell concentric to the moon, and touching the earth; ab, any diameter of that ſhell perpendicular to a great circle of the moon's body, repreſented by its diameter cd; e the place of the ſhell receiving full moon light from the bright hemiſphere fdg. Now, becauſe the ſurface of the moon is rough like that of the earth, we may allow that the ſun's rays, incident upon any ſmall part of it, with any obliquity, are reflected from it every way alike, as if they were emitted. And therefore, if the ſegment df ſhone alone, the points a, e, would be equally illuminated by it; and likewiſe if the remaining bright ſegment dg ſhone alone, the points be would be equally illuminated by it. Conſequently, if the light at the point a was increaſed by the light at b, it would become equal to the full moon light at e. And conceiving the ſame transfer to be made from every point of the hemiſpherical ſurface $hbik$ to their oppoſite points in the hemiſphere $kaeh$, the former hemiſphere would be left quite dark, and the latter would be uniformly illuminated with full moon light; ariſing from a quantity of the ſun's light, which immediately before its incidence on the moon, would uniformly illuminate a circular plane equal to a great circle of her body, called her *diſk*. Therefore the quantities of light being the ſame upon both ſurfaces, the denſity of the ſun's incident light is to the denſity of full moon light, as that hemiſpherical ſurface hek is to the ſaid diſk; that is, as any other hemiſpherical ſurface whoſe centre is at the eye, to that part of it which the moon's diſk appears to poſſeſs very nearly, becauſe it ſubtends but a ſmall angle at the eye: that is, as radius of the hemiſphere to the verſed ſine of the moon's apparent ſemidiameter, or as 10,000,000 to $1106\frac{2}{3}$ or as 90,400 to 1; taking the moon's mean horizontal diameter to be 16′ 7″.

"Strictly ſpeaking, this rule compares moon light at the earth with day light at the moon; the medium of which, at her quadratures, is the ſame as our day-light; but is leſs at her full in the duplicate ratio of 365 to 366, or thereabout, that is, of the ſun's diſtances from the earth and full moon; and therefore full moon light would be to our day-light as about 1 to 90,900, if no rays were loſt at the moon.

"Secondly, I ſay that full moon light is to any other moon light as the whole diſk of the moon to the part that appears enlightened, conſidered upon a plane ſurface. For now let the earth be at b, and let dl be perpendicular to fg, and gm to cd: then it is plain, that gl is equal to dm; and that gl is equal to a perpendicular ſection of the ſun's rays incident upon the arch dg which at b appears equal to dm; the eye being unable to diſtinguiſh the unequal diſtances of its parts. In like manner, conceiving the moon's ſurface to conſiſt of innumerable phyſical circles parallel to $efdg$, as repreſented at A, the ſame reaſon holds for every one of theſe circles as for $cfdg$. It follows then, that the bright part of the ſurface viſible at b, when reduced to a flat as repreſented at B, by the creſcent $pdqmp$, will be equal and ſimilar to a perpendicular ſection of all the rays incident on that part, repreſented at C by the creſcent $pgqlp$. Now the whole diſk being in proportion to this creſcent, as the quantities of light incident upon them; and the light falling upon every rough particle, being equally rarefied in diverging to the eye at b, conſidered as equidiſtant from them all; it follows, that full moon light is to this moon light as the whole diſk $pdqc$ to the creſcent $pdqmp$. Fig. 9.

"Therefore, by compounding this ratio with that in the former remark, day light is to moon light as the ſurface of an hemiſphere whoſe centre is at the eye, to the part of that ſurface which appears to be poſſeſſed by the enlightened part of the moon."

272 Mr Michell's calculation.

Mr Michell made his computation in a much more ſimple and eaſy manner, and in which there is much leſs danger of falling into any miſtake. Conſidering the diſtance of the moon from the ſun, and that the denſity of the light muſt decreaſe in the proportion of the ſquare of that diſtance, he calculated the denſity of the ſun's light, at that diſtance, in proportion to its denſity at the ſurface of the ſun; and in this manner he found, that if the moon reflected all the light it receives from the ſun, it would only be the 45,000th part of the light we receive from the greater luminary. Admitting, therefore, that moon light is only a 300,000th part of the light of the ſun, Mr Michell concludes, that it reflects no more than between the 6th and 7th part of what falls upon it.

273 Rumford's photometer.

Count Rumford, has conſtructed a *photometer*, in which the ſhadows, inſtead of being thrown upon a paper ſpread out upon the wainſcot, or ſide of the room, are projected upon the inſide of the back part of

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of a wooden box $7\frac{1}{4}$ inches wide, $10\frac{1}{2}$ inches long, and $3\frac{1}{4}$ inches deep, in the clear. The light is admitted into it through two horizontal tubes in the front, placed ſo as to form an angle of 60° ; their axes meeting at the centre of the field of the inſtrument. In the middle of the front of the box, between theſe two tubes, is an opening through which is viewed the field of the photometer (ſee fig. 5.). This field is formed of a piece of white paper, which is not faſtened immediately upon the inſide of the back of the box, but is paſted upon a ſmall pane of very ſine ground glaſs; and this glaſs, thus covered, is let down into a groove, made to receive it, in the back of the box. The whole inſide of the box, except the field of the inſtrument, is painted of a deep black dead colour. To the under part of the box is fitted a ball and ſocket, by which it is attached to a ſtand which ſupports it; and the top or lid of it is fitted with hinges, in order that the box may be laid quite open, as often as it is neceſſary to alter any part of the machinery it contains.

Plate CCCLXXXIX. Fig. 5.

The count had found it very inconvenient to compare two ſhadows projected by the ſame cylinder, as theſe were either neceſſarily too far from each other to be compared with certainty, or, when they were nearer, were in part hid from the eye by the cylinder. To remedy this inconvenience, he now makes uſe of two cylinders, which are placed perpendicularly in the bottom of the box juſt deſcribed, in a line parallel to the back part of it, diſtant from this back $2\frac{2}{10}$ inches, and from each other 3 inches, meaſuring from the centres of the cylinders; when the two lights made uſe of in the experiment are properly placed, theſe two cylinders project four ſhadows upon the white paper upon the inſide of the back part of the box, or the *field* of the inſtrument; two of which ſhadows are in contact, preciſely in the middle of that field, and it is theſe two alone that are to be attended to. To prevent the attention being diſtracted by the preſence of unneceſſary objects, the two outſide ſhadows are made to diſappear; which is done by rendering the field of the inſtrument ſo narrow, that they fall without it, upon a blackened ſurface, upon which they are not viſible. If the cylinders be each $\frac{4}{10}$ of an inch in diameter, and $2\frac{2}{10}$ inches in height, it will be quite ſufficient that the field be $2\frac{7}{10}$ inches wide; and as an unneceſſary height of the field is not only uſeleſs, but diſadvantageous, as a large ſurface of white paper not covered by the ſhadows produces too ſtrong a glare of light, the field ought not to be more than $\frac{3}{10}$ of an inch higher than the tops of the cylinders. That its dimenſions, however, may be occaſionally augmented, the covered glaſs ſhould be made $5\frac{1}{2}$ inches long, and as wide as the box is deep, viz. $3\frac{1}{4}$ inches; ſince the field of the inſtrument can be reduced to its proper ſize by a ſcreen of black paſteboard, interpoſed before the anterior ſurface of this covered glaſs, and reſting immediately upon it. A hole in this paſteboard, in the form of an oblong ſquare, $1\frac{7}{10}$ inch wide, and two inches high, determines the dimenſions, and forms the boundaries of the field. This ſcreen ſhould be large enough to cover the whole inſide of the back of the box, and it may be fixed in its place by means of grooves in the ſides of the box, into which it may be made to enter. The poſition of the opening above-mentioned is determined by the height of the cylinders; the top of it being $\frac{3}{10}$ of an inch higher than the tops of the cylinders; and as the height of it is only two inches, while the height of the cylinders is $2\frac{2}{10}$ inches, it is evident that the ſhadows of the lower parts of the cylinders do not enter the field. No inconvenience ariſes from that circumſtance; on the contrary, ſeveral advantages are derived from that arrangement.

That the lights may be placed with facility and preciſion, a fine black line is drawn through the middle of the field, from the top to the bottom of it, and another (horizontal) line at right angles to it, at the height of the top of the cylinders. When the tops of the ſhadows touch this laſt mentioned line, the lights are at a proper height; and farther, when the two ſhadows are in contact with each other in the middle of the field, the lights are then in their proper directions.

We have ſaid that the cylinders, by which the ſhadows are projected, are placed perpendicularly in the bottom of the box; but as the diameters of the ſhadows of theſe cylinders vary in ſome degree, in proportion as the lights are broader or narrower, and as they are brought nearer to or removed farther from the photometer, in order to be able in all caſes to bring theſe ſhadows to be of the ſame diameter, which is very advantageous, in order to judge with greater facility and certainty when they are of the ſame denſity, the count renders the cylinders moveable about their axes, and adds to each a vertical wing $\frac{11}{20}$ of an inch wide, $\frac{1}{10}$ of an inch thick, and of equal height with the cylinder itſelf, and firmly fixed to it from the top to the bottom. This wing commonly lies in the middle of the ſhadow of the cylinder, and as long as it remains in that ſituation it has no effect whatever; but when it is neceſſary that the diameter of one of the ſhadows be increaſed, the correſponding cylinder is moved about its axis, till the wing juſt deſcribed, emerging out of the ſhadow, and intercepting a portion of light, brings the ſhadow projected upon the field of the inſtrument to be of the width or diameter required. In this operation it is always neceſſary to turn the cylinder outwards, or in ſuch a manner that the augmentation of the width of the ſhadow may take place on that ſide of it which is oppoſite to the ſhadow correſponding to the other light. The neceſſity for that precaution will appear evident to any one who has a juſt idea of the inſtrument in queſtion, and of the manner of making uſe of it. They are turned likewiſe without opening the box, by taking hold of the ends of their axes, which project below its bottom.

As it is abſolutely neceſſary that the cylinders ſhould conſtantly remain preciſely perpendicular to the bottom of the box, or parallel to each other, it will be beſt to conſtruct them of braſs; and, inſtead of fixing them immediately to the bottom of the box (which, being of wood, may warp), to fix them to a ſtrong thick piece of well-hammered plate braſs; which plate of braſs may be afterwards faſtened to the bottom of the box by means of one ſtrong ſcrew. In this manner two of the count's beſt inſtruments are conſtructed; and, in order to ſecure the cylinders ſtill more firmly in their vertical poſitions, they are furniſhed with broad flat rings, or projections, where they reſt upon the braſs plate; which rings are $\frac{1}{10}$ of an inch thick, and equal in diameter to the projection of the wing of the cylinder, to the bottom of which they afford a firm ſupport. Theſe cylinders are likewiſe forcibly puſhed, or rather pulled, againſt

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againſt the braſs plate upon which they reſt, by means of compreſſed ſpiral ſprings placed between the under ſide of that plate and the lower ends of the cylinders. Of whatever material the cylinders be conſtructed, and whatever be their forms or dimenſions, it is abſolutely neceſſary that they, as well as every other part of the photometer, except the field, ſhould be well painted of a deep black dead colour.

In order to move the lights to and from the photometer with greater eaſe and preciſion, the obſerver ſhould provide two long and narrow, but very ſtrong and ſteady, tables; in the middle of each of which there is a ſtraight groove, in which a ſliding carriage, upon which the light is placed, is drawn along by means of a cord which is faſtened to it before and behind, and which, paſſing over pulleys at each end of the table, goes round a cylinder; which cylinder is furniſhed with a winch, and is ſo placed, near the end of the table adjoining the photometer, that the obſerver can turn it about, without taking his eye from the field of the inſtrument.

Many advantages are derived from this arrangement: Firſt, the obſerver can move the lights as he finds neceſſary, without the help of an aſſiſtant, and even without removing his eye from the ſhadows; ſecondly, each light is always preciſely in the line of direction in which it ought to be, in order that the ſhadows may be in contact in the middle of the vertical plane of the photometer; and, thirdly, the ſliding motion of the lights being perfectly ſoft and gentle, that motion produces little or no effect upon the lights themſelves, either to increaſe or diminiſh their brilliancy.

Theſe tables muſt be placed at an angle of 60 degrees from each other, and in ſuch a ſituation, with reſpect to the photometer, that lines drawn through their middles, in the direction of their lengths, meet in a point exactly under the middle of the vertical plane or field of the photometer, and from that point the diſtances of the lights are meaſured; the ſides of the tables being divided into Engliſh inches, and a vernier, ſhewing tenths of inches, being fixed to each of the ſliding carriages upon which the lights are placed, and which are ſo contrived that they may be raiſed or lowered at pleaſure; ſo that the lights may be always in a horizontal line with the tops of the cylinders of the photometer.

In order that the two long and narrow tables or platforms, juſt deſcribed, may remain immoveable in their proper poſitions, they are both firmly fixed to the ſtand which ſupports the photometer; and, in order that the motion of the carriages which carry the lights may be as ſoft and gentle as poſſible, they are made to ſlide upon parallel braſs wires, 9 inches aſunder, about $\frac{1}{10}$ of an inch in diameter, and well poliſhed, which are ſtretched out upon the tables from one end to the other.

Plate CCCLXXXIX. Fig. 5.

The ſtructure of the apparatus will be clearly underſtood by a bare inſpection of Plate CCCLXXXIX. Fig. 5. is a plan of the inſide of the box, and the adjoining parts of the photometer. Fig. 6. Plan of the two tables belonging to the photometer. Fig. 7. The box of the photometer on its ſtand. Fig. 8. Elevation of the photometer, with one of the tables and carriages.

Having ſufficiently explained all the eſſential parts of this photometer, it remains for us to give ſome account of the precautions neceſſary to be obſerved in uſing it. And, firſt, with reſpect to the diſtance at which lights, whoſe intenſities are to be compared, ſhould be placed from the field of the inſtrument, the ingenious and accurate inventor found, that when the weakeſt of the lights in queſtion is about as ſtrong as a common wax candle, that light may moſt advantageouſly be placed from 30 to 36 inches from the centre of the field; and when it is weaker or ſtronger, proportionally nearer or farther off. When the lights are too near, the ſhadows will not be well defined; and when they are too far off, they will be too weak.

It will greatly facilitate the calculations neceſſary in drawing concluſions from experiments of this kind, if ſome ſteady light, of a proper degree of ſtrength for that purpoſe, be aſſumed as a ſtandard by which all others may be compared. Our author found a good Argand's lamp much preferable for this purpoſe to any other lamp or candle whatever. As it appears, he ſays, from a number of experiments, that the quantity of light emitted by a lamp, which burns in the ſame manner with a clear flame, and *without ſmoke*, is in all caſes as the quantity of oil conſumed, there is much reaſon to ſuppoſe, that, if the Argand's lamp be ſo adjuſted as always to conſume a given quantity of oil in a given time, it may then be depended on as a juſt ſtandard of light.

In order to abridge the calculation neceſſary in theſe inquiries, it will always be advantageous to place the ſtandard-lamp at the diſtance of 100 inches from the photometer, and to aſſume the intenſity of its light at its ſource equal to unity; in this caſe (calling this ſtandard light A, the intenſity of the light at its ſource $=x=1$, and the diſtance of the lamp from the field of the photometer $=m=100$), the intenſity of the illumination at the field of the photometer $\left(=\frac{x}{m^2}\right)$ will be expreſſed by the fraction $\frac{1}{100^2}=\frac{1}{10000}$; and the relative intenſity of any other light which is compared with it, may be found by the following proportion: Calling this light B, putting $y=$ its intenſity at its ſource, and $n=$ its diſtance from the field of the photometer, expreſſed in Engliſh inches, as it is $\frac{y}{n^2}=\frac{x}{m^2}$, or, inſtead of $\frac{x}{m^2}$, writing its value $=\frac{1}{10000}$, it will be $\frac{y}{n^2}=\frac{1}{10000}$; and conſequently y is to 1 as n^2 is to 10000; or the intenſity of the light B at its ſource, is to the intenſity of the ſtandard light A at its ſource, as the ſquare of the diſtance of the light B from the middle of the field of the inſtrument, expreſſed in inches, is to 10000; and hence it is $y=\frac{n^2}{10000}$.

Or, if the light of the ſun, or that of the moon, be compared with the light of a given lamp or candle C, the reſult of ſuch compariſon may be beſt expreſſed in words, by ſaying, that the light of the celeſtial luminary in queſtion, *at the ſurface of the earth*, or, which is the ſame thing, at the field of the photometer, is equal to the light of the given lamp or candle, *at the diſtance found by the experiment*; or, putting $a=$ the intenſity of the light of this lamp C at its ſource, and $p=$ its diſtance,

diſtance, in inches, from the field, when the ſhadows correſponding to this light, and that correſponding to the celeſtial luminary in queſtion, are found to be of equal denſities, and putting $z =$ the intenſity of the rays of the luminary at the ſurface of the earth, the reſult of the experiment may be expreſſed thus, $z = \frac{a}{p^2}$; or the real value of a being determined by a particular experiment, made expreſsly for that purpoſe with the ſtandard lamp, that value may be written inſtead of it. When the ſtandard lamp itſelf is made uſe of, inſtead of the lamp C, then the value of A will be 1.

The count's firſt attempts with his photometer were to determine how far it might be poſſible to aſcertain, by direct experiments, the certainty of the aſſumed law of the diminution of the intenſity of the light emitted by luminous bodies; namely, that the intenſity of the light is everywhere as the ſquares of the diſtances from the luminous body inverſely. As it is obvious that this law can hold good only when the light is propagated through perfectly tranſparent ſpaces, ſo that its intenſity is weakened merely by the divergency of its rays, he inſtituted a ſet of experiments to aſcertain the tranſparency of the air and other mediums.

With this view, two equal wax candles, well trimmed, and which were found, by a previous experiment, to burn with exactly the ſame degree of brightneſs, were placed *together*, on one ſide, before the photometer, and their united light was counterbalanced by the light of an Argand's lamp, well trimmed, and burning very equally, placed on the other ſide over againſt them. The lamp was placed at the diſtance of 100 inches from the field of the photometer, and it was found that the two burning candles (which were placed as near together as poſſible, without their flames affecting each other by the currents of air they produced) were juſt able to counterbalance the light of the lamp at the field of the photometer, when they were placed at the diſtance of 60.8 inches from that field. One of the candles being now taken away and extinguiſhed, the other was brought nearer to the field of the inſtrument, till its light was found to be juſt able, ſingly, to counterbalance the light of the lamp; and this was found to happen when it had arrived at the diſtance of 43.4 inches. In this experiment, as the candles burnt with equal brightneſs, it is evident that the intenſities of their united and ſingle lights were as 2 to 1, and in that proportion ought, according to the aſſumed theory, the ſquares of the diſtances, 60.8 and 43.4, to be; and, in fact, $\overline{60.8}^2 = 3696.64$ is to $\overline{43.4}^2 = 1883.56$ as 2 is to 1 very nearly.

Again, in another experiment, the diſtances were,

With two candles = 54 inches.	Square	=	2916
With one candle = 38.6	-	=	1489.96

Upon another trial,

With two candles = 54.6 inches.	Square	=	2981.16
With one candle = 39.7	-	=	1576.09

And, in the fourth experiment,

With two candles = 58.4 inches.	Square	=	3410.56
With one candle = 42.2	-	=	1780.84

And, taking the mean of the reſults of theſe four experiments,

	Squares of the Diſtances With two Candles.		Squares of the Diſtances With one Candle.
In the Experiment N° 1.	3696.64	—	1883,56
N° 2.	2916	—	1489.96
N° 3.	2981.16	—	1576.09
N° 4.	3410.56	—	1780.84
	4)13004.36		4)6730.45
Means	3251.09	and	1682.61

which again are very nearly as 2 to 1.

With regard to theſe experiments, it may be obſerved, that were the reſiſtance of the air to light, or the diminution of the light from the imperfect tranſparency of air, ſenſible within the limits of the inconſiderable diſtances at which the candles were placed from the photometer, in that caſe the diſtance of the two equal lights united ought to be, to the diſtance of one of them ſingle, in a ratio leſs than that of the ſquare root of 2 to the ſquare root of 1. For if the intenſity of a light emitted by a luminous body, *in a ſpace void of all reſiſtance*, be diminiſhed in the proportion of the ſquares of the diſtances, it muſt of neceſſity be diminiſhed in a ſtill higher ratio when the light paſſes through a reſiſting medium, or one which is not perfectly tranſparent; and from the difference of thoſe ratios, namely, that of the ſquares of the diſtances, and that other higher ratio found by the experiment, the reſiſtance of the medium might be aſcertained. This he took much pains to do with reſpect to air, but did not ſucceed; the tranſparency of air being ſo great, that the diminution which light ſuffers in paſſing through a few inches, or even through ſeveral feet of it, is not ſenſible.

Having found, upon repeated trials, that the light of a lamp, properly trimmed, is incomparably more equal than that of a candle, whoſe wick, continually growing longer, renders its light extremely fluctuating, he ſubſtituted lamps to candles in theſe experiments, and made ſuch other variations in the manner of conducting them as he thought bid fair to lead to a diſcovery of the reſiſtance of the air to light, were it poſſible to render that reſiſtance ſenſible within the confined limits of his machinery. But the reſults of them, ſo far from affording means for aſcertaining the reſiſtance of the air to light, do not even indicate any reſiſtance at all; on the contrary, it might almoſt be inferred, from ſome of them, that the intenſity of the light emitted by a luminous body in air is diminiſhed in a ratio *leſs* than that of the ſquares of the diſtances; but as ſuch a concluſion would involve an evident abſurdity, namely, that light moving in air, its abſolute quantity, inſtead of being diminiſhed, actually goes on to *increaſe*, that concluſion can by no means be admitted.

Why not? Theories muſt give place to facts; and if this fact can be fairly aſcertained, inſtead of rejecting the concluſion, we ought certainly to rectify our notions of light, the nature of which we believe no man fully comprehends. Who can take it upon him to ſay, that the ſubſtance of light is not latent in the atmoſphere, as heat or caloric is now acknowledged to be latent, and that the agency of the former is not called forth by the paſſage of a ray through a portion of air, as the agency of the latter is known to be excited by

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by the combination of oxygen with any combuſtible ſubſtance?

The ingenious author's experiments all conſpired to ſhew that the reſiſtance of the air to light is too inconſiderable to be perceptible, and that the aſſumed law of the diminution of the intenſity of light may be depended upon with ſafety. He admits, however, that means may be found for rendering the air's reſiſtance to light apparent; and he ſeems to have thought of the very means which occurred for this purpoſe to M. de Sauſſure.

274 Contrivances of Sauſſure.

That eminent philoſopher, wiſhing to aſcertain the tranſparency of the atmoſphere, by meaſuring the diſtances at which determined objects ceaſe to be viſible, perceived at once that his end would be attained, if he ſhould find objects of which the diſappearance might be accurately determined. Accordingly, after many trials, he found that the moment of diſappearance can be obſerved with much greater accuracy when a black object is placed on a white ground, than when a white object is placed on a black ground; that the accuracy was ſtill greater when the obſervation was made in the ſun than in the ſhade; and that even a ſtill greater degree of accuracy was obtained, when the white ſpace ſurrounding a black circle, was itſelf ſurrounded by a circle or ground of a dark colour. This laſt circumſtance was particularly remarkable, and an obſervation quite new.

If a circle totally black, of about two lines in diameter, be faſtened on the middle of a large ſheet of paper or paſteboard, and if this paper or paſteboard be placed in ſuch a manner as to be expoſed fully to the light of the ſun, if you then approach it at the diſtance of three or four feet, and afterwards gradually recede from it, keeping your eye conſtantly directed towards the black circle, it will appear always to decreaſe in ſize the farther you retire from it, and at the diſtance of 33 or 34 feet will have the appearance of a point. If you continue ſtill to recede, you will ſee it again enlarge itſelf; and it will ſeem to form a kind of cloud, the darkneſs of which decreaſes more and more according as the circumference becomes enlarged. The cloud will appear ſtill to increaſe in ſize the farther you remove from it; but at length it will totally diſappear. The moment of the diſappearance, however, cannot be accurately aſcertained; and the more experiments were repeated the more were the reſults different.

M. de Sauſſure, having reflected for a long time on the means of remedying this inconveniency, ſaw clearly, that, as long as this cloud took place, no accuracy could be obtained; and he diſcovered that it appeared in conſequence of the contraſt formed by the white parts which were at the greateſt diſtance from the black circle. He thence concluded, that if the ground was left white near this circle, and the parts of the paſteboard at the greateſt diſtance from it were covered with a dark colour, the cloud would no longer be viſible, or at leaſt almoſt totally diſappear.

This conjecture was confirmed by experiment. M. de Sauſſure left a white ſpace around the black circle equal in breadth to its diameter, by placing a circle of black paper a line in diameter on the middle of a white circle three lines in diameter, ſo that the black circle was only ſurrounded by a white ring a line in breadth. The whole was paſted upon a green ground. A green colour was choſen, becauſe it was dark enough to make the cloud diſappear, and the eaſieſt to be procured.

The black circle, ſurrounded in this manner with white on a green ground, diſappeared at a much leſs diſtance than when it was on a white ground of a large ſize.

If a perfectly black circle, a line in diameter, be paſted on the middle of a white ground expoſed to the open light, it may be obſerved at the diſtance of from 44 to 45 feet; but if this circle be ſurrounded by a white ring a line in breadth, while the reſt of the ground is green, all ſight of it is loſt at the diſtance of only $15\frac{1}{2}$ feet.

According to theſe principles M. de Sauſſure delineated ſeveral black circles, the diameters of which increaſed in a geometrical progreſſion, the exponent of which was $\frac{3}{2}$. His ſmalleſt circle was $\frac{1}{5}$ or 0.2 of a line in diameter; the ſecond 0.3; the third, 0.45; and ſo on to the ſixteenth, which was 87.527, or about 7 inches $3\frac{1}{2}$ lines. Each of theſe circles was ſurrounded by a white ring, the breadth of which was equal to the diameter of the circle, and the whole was paſted on a green ground.

M. de Sauſſure, for his experiments, ſelected a ſtraight road or plain of about 1200 or 1500 feet in circumference, which towards the north was bounded by trees or an aſcent. Thoſe who repeat them, however, muſt pay attention to the following remarks: When a perſon retires backwards, keeping his eye conſtantly fixed on the paſteboard, the eye becomes fatigued, and ſoon ceaſes to perceive the circle; as ſoon therefore as it ceaſes to be diſtinguiſhable, you muſt ſuffer your eyes to reſt; not, however, by ſhutting them, for they would when again opened be dazzled by the light, but by turning them gradually to ſome leſs illuminated object in the horizon. When you have done this for about half a minute, and again directed your eyes to the paſteboard, the circle will be again viſible, and you muſt continue to recede till it diſappear once more. You muſt then let your eyes reſt a ſecond time in order to look at the circle again, and continue in this manner till the circle becomes actually inviſible.

If you wiſh to find an accurate expreſſion for the want of tranſparency, you muſt employ a number of circles, the diameters of which increaſe according to a certain progreſſion; and a compariſon of the diſtances at which they diſappear will give the law according to which the tranſparency of the atmoſphere decreaſes at different diſtances. If you wiſh to compare the tranſparency of the atmoſphere on two days, or in two different places, two circles will be ſufficient for the experiment.

According to theſe principles, M. de Sauſſure cauſed to be prepared a piece of white linen cloth eight feet ſquare. In the middle of this ſquare he ſewed a perfect circle, two feet in diameter, of beautiful black wool; around this circle he left a white ring two feet in breadth, and the reſt of the ſquare was covered with pale green. In the like manner, and of the ſame materials, he prepared another ſquare; which was, however, equal to only $\frac{1}{12}$ of the ſize of the former, ſo that each ſide of it was 8 inches; the black circle in the middle was two inches in diameter, and the white ſpace around the circle was 2 inches alſo.

If two ſquares of this kind be ſuſpended vertically and

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and parallel to each other, so that they may be both illuminated in an equal degree by the sun; and if the atmosphere, at the moment when the experiment is made, be perfectly transparent, the circle of the large square, which is twelve times the size of the other, must be seen at twelve times the distance. In M. de Saussure's experiments the small circle disappeared at the distance of 314 feet, and the large one at the distance of 3588 feet, whereas it should have disappeared at the distance of 3768. The atmosphere, therefore, was not perfectly transparent. This arose from the thin vapours which at that time were floating in it. M. de Saussure, calls his instrument a *diaphanometer;* but it serves one of the purposes of a photometer.

From a number of experiments made with the *photometer*, Count Rumford found, that, by passing through a pane of fine, clear, well polished glass, such as is commonly made use of in the construction of looking-glasses, light loses .1973 of its whole quantity, *i.e.* of the quantity which impinged on the glass; that when light is made to pass through two panes of such glass standing parallel, but not touching each other, the loss is .3184 of the whole; and that in passing through a very thin, clear, colourless pane of window-glass, the loss is only .1263. Hence he infers, that this apparatus might be very usefully employed by the optician, to determine the degree of transparency of glass, and direct his choice in the provision of that important article of his trade. The loss of light when reflected from the very best plain glass mirror, the author ascertained, by five experiments, to be $\frac{1}{3}$d of the whole which fell upon the mirror.

275 Leslie's photometer.

An ingenious photometer has also been invented by Professor Leslie, and fully described in his celebrated work on Heat, to which we must refer the reader for a complete description of this instrument. It measures the calorific effect of heat, and is founded upon this principle, "that if a body be exposed to the sun's rays, it will, in every possible case, be found to indicate a measure of heat exactly proportioned to the quantity of light which it has absorbed." See *Essay on Heat*, p. 103.

CHAP. II. *On the method of forming the Lenses and Specula, of Refracting and Reflecting Telescopes.*

SECT. I. *On the Method of grinding and polishing Lenses.*

276 On grinding lenses.

HAVING fixed upon the proper aperture and focal distance of the lens, take a piece of sheet copper, and strike a fine arch upon its surface, with a radius equal to half that distance, if it is to be plano-convex, and let the length of this arch be a little greater than the given aperture. Remove with a file that part of the copper which is without the circular arch, and a *convex gage* will be formed. Strike another arch with the same radius, and having removed that part of the copper which is within it, a *concave gage* will be obtained. Prepare two circular plates of brass, about $\frac{1}{10}$ of an inch thick, and half an inch greater in diameter than the breadth of the lens, and solder them upon a cylinder of lead of the same diameter, and about an inch high. These tools are then to be fixed upon a turning lathe, and one of them turned into a portion of a concave sphere, so as to suit the convex gage; and the other into a portion of a convex sphere, so as to answer the concave gage. After the surfaces of the brass plates are turned as accurately as possible, they must be ground upon one another, alternately, with flour emery; and when the two surfaces exactly coincide, the grinding tools will be ready for use.

Method of Grinding and Polishing Lenses.

277 Formation of the gages.

278 Formation of the tools.

279 Formation of the glass.

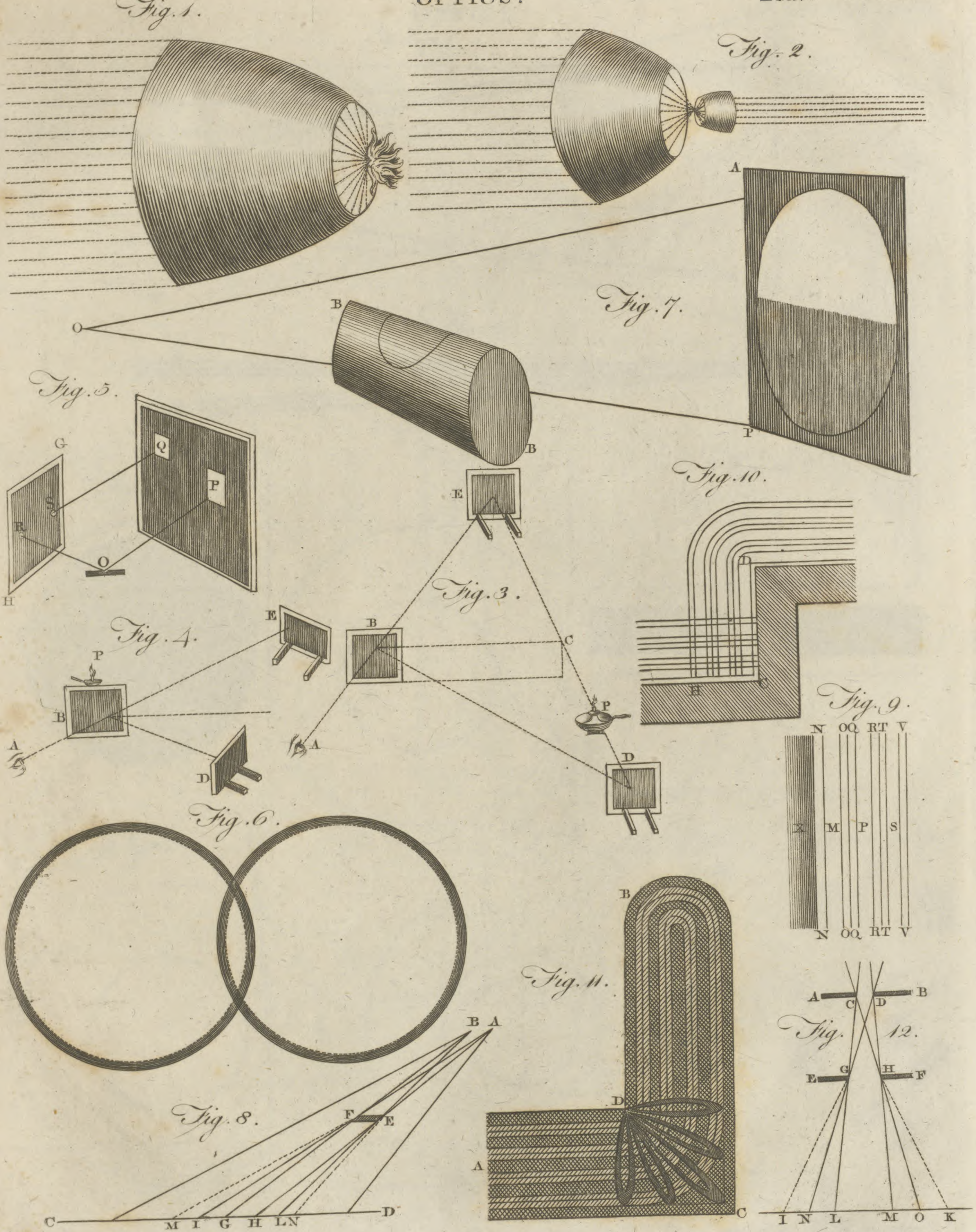
Procure a piece of glass whose dispersive power is as small as possible, if the lens is not for achromatic instruments, and whose surfaces are parallel; and by means of a pair of large scissars or pincers, cut it into a circular shape, so that its diameter may be a little greater than the required aperture of the lens. When the roughness is removed from its edges by a common grindstone (A), it is to be fixed with black pitch to a wooden handle of a smaller diameter than the glass, and about an inch high, so that the centre of the handle may exactly coincide with the centre of the glass.

280 Mode of grinding.

The glass being thus prepared, it is then to be ground with fine emery upon the concave tool, if it is to be convex, and upon the convex tool, if it is to be concave. To avoid circumlocution, we shall suppose that the lens is to be convex. The concave tool, therefore, which is to be used, must be firmly fixed to a table or bench, and the glass wrought upon it with circular strokes, so that its centre may never go beyond the edges of the tool. For every 6 circular strokes, the glass should receive 2 or 3 cross ones along the diameter of the tool, and in different directions. When the glass has received its proper shape, and touches the tool in every point of its surface, which may be easily known by inspection, the emery is to be washed away, and finer kinds (B) successively substituted in its room, till by the same alternation of circular and transverse strokes, all the scratches and asperities are removed from its surface. After the finest emery has been used, the roughness which remains may be taken away, and a slight polish superinduced by grinding the glass with pounded pumice-stone, in the same manner as before. While the operation of grinding is going on, the convex tool should, at the end of every five

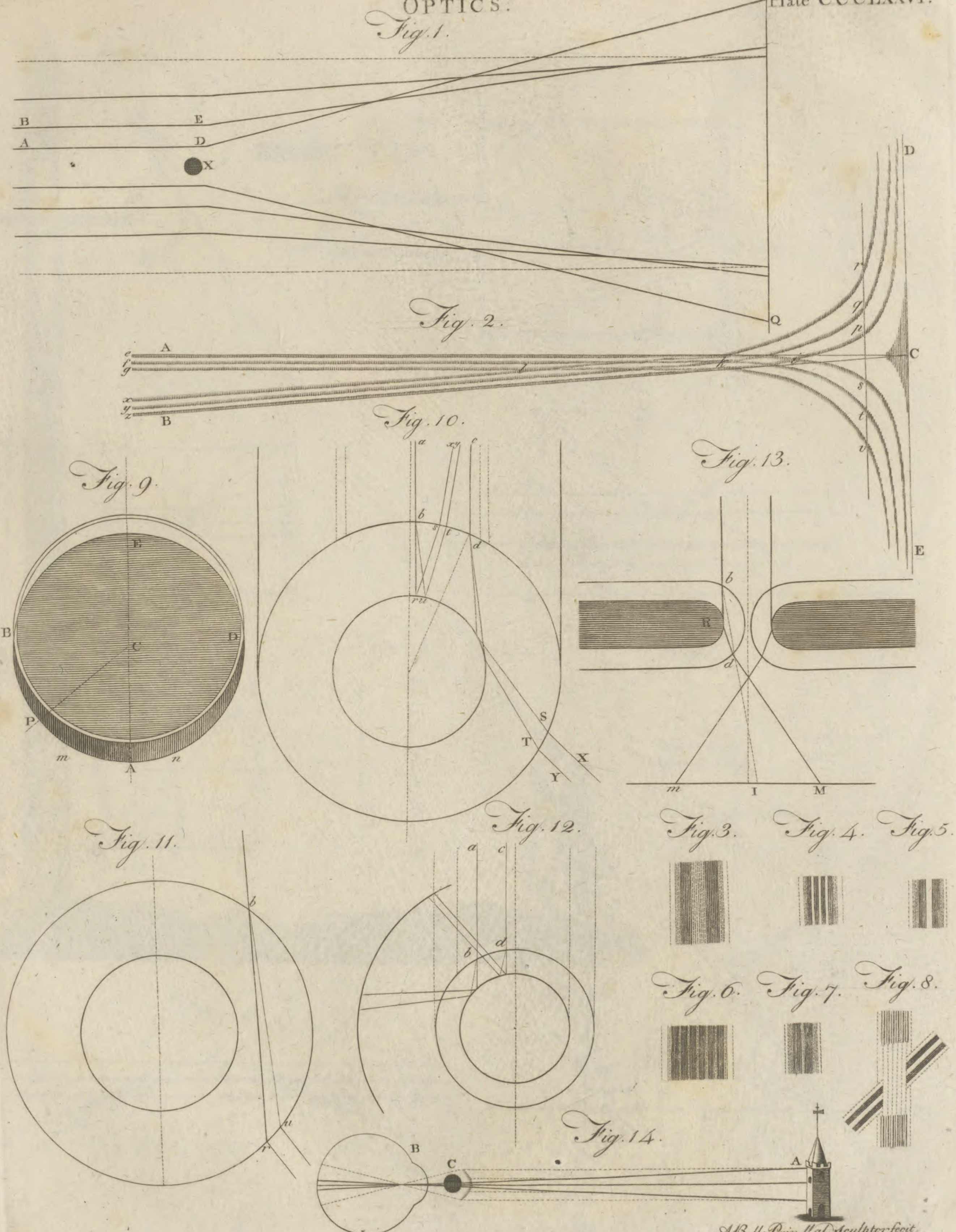
(A) When the focal distance of the lens is to be short, the surface of the piece of glass should be ground upon a common grindstone, so as to suit the gage as nearly as possible; and the plates of brass, before they are soldered on the lead, should be hammered as truly as they can be done into their proper form. By this means much labour will be saved both in turning and grinding.

(B) Emery of different degrees of fineness may be made in the following manner. Take five or six clean vessels, and having filled one of them with water, put into it a considerable quantity of flour emery. Stir it well with a piece of wood, and after standing for 5 seconds pour the water into the second vessel. After it has stood about 12 seconds, pour it out of this into a third vessel, and so on with the rest; and at the bottom of each vessel will be found emery of different degrees of fineness, the coarsest being in the first vessel, and the finest in the last.



A. Bell Prin. Wal. Sculptor fecit.

OPTICS. Plate CCCLXXVI.



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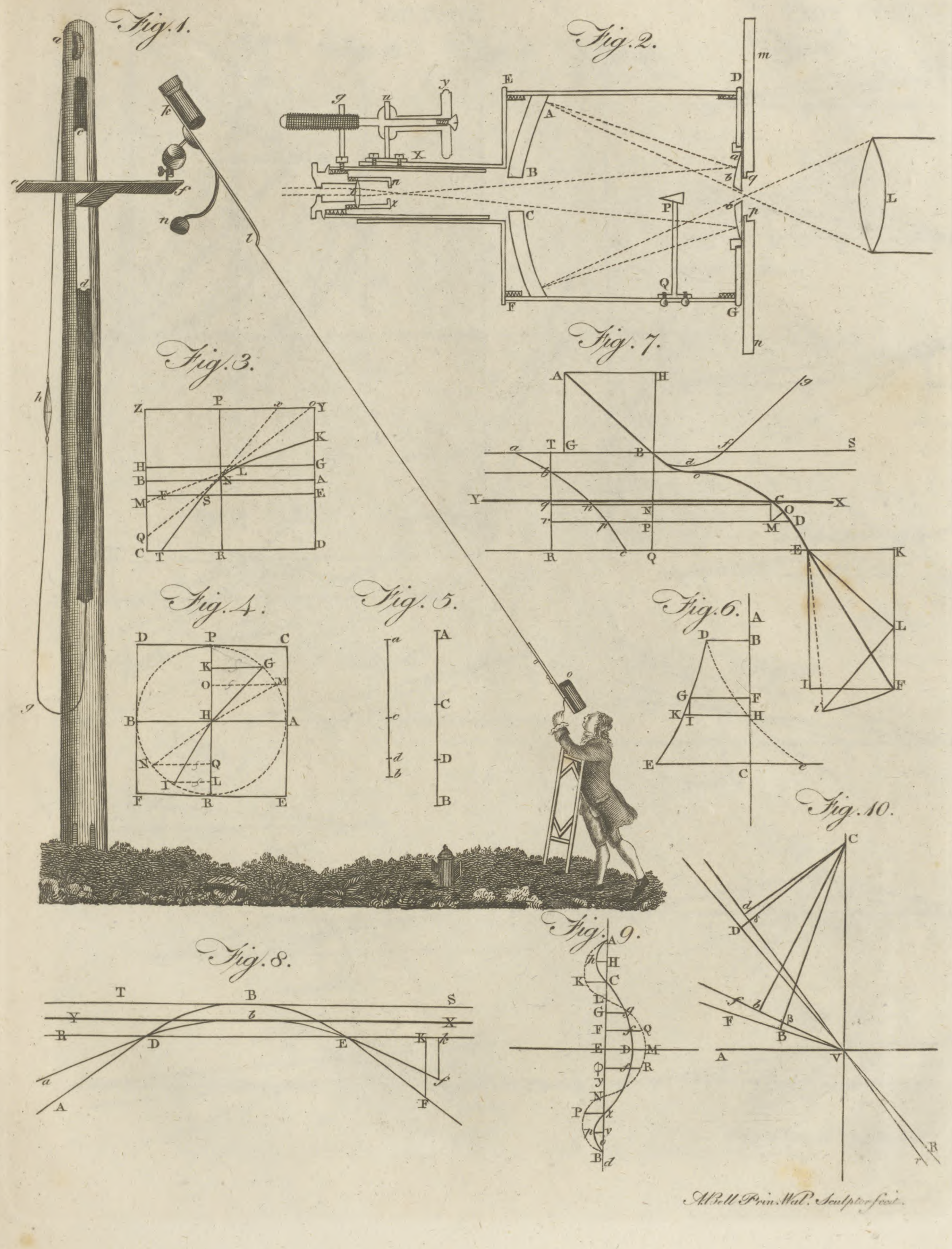

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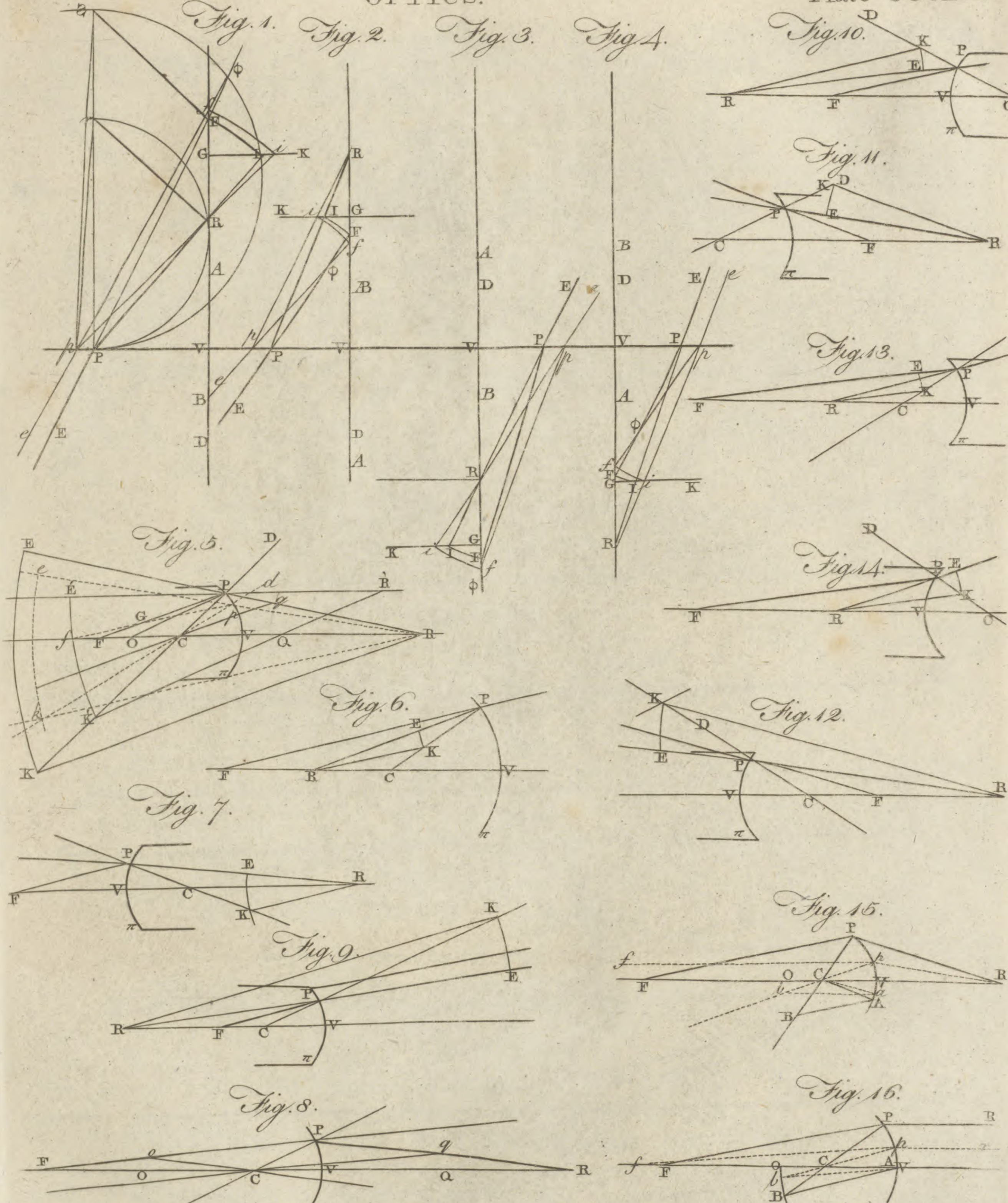

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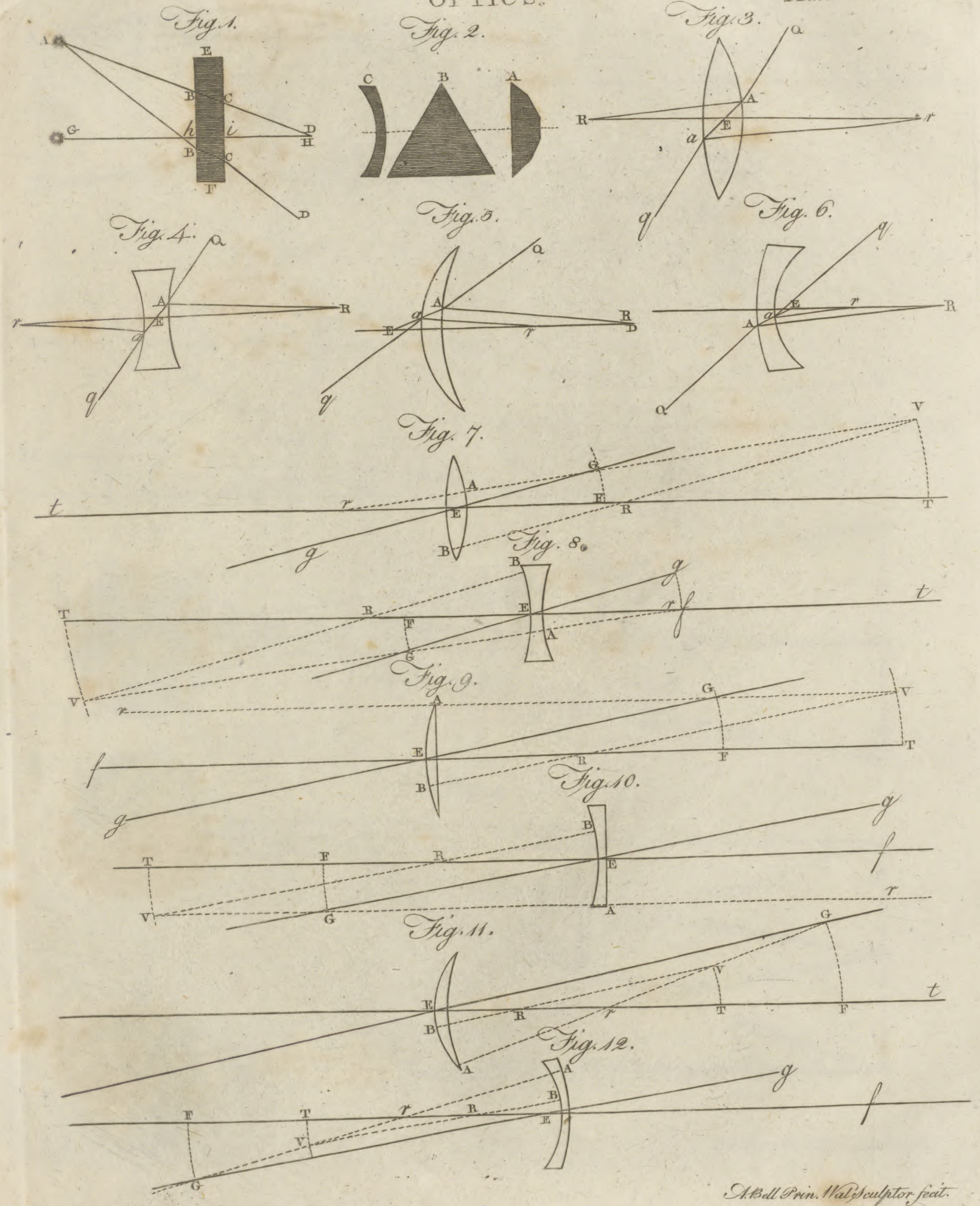

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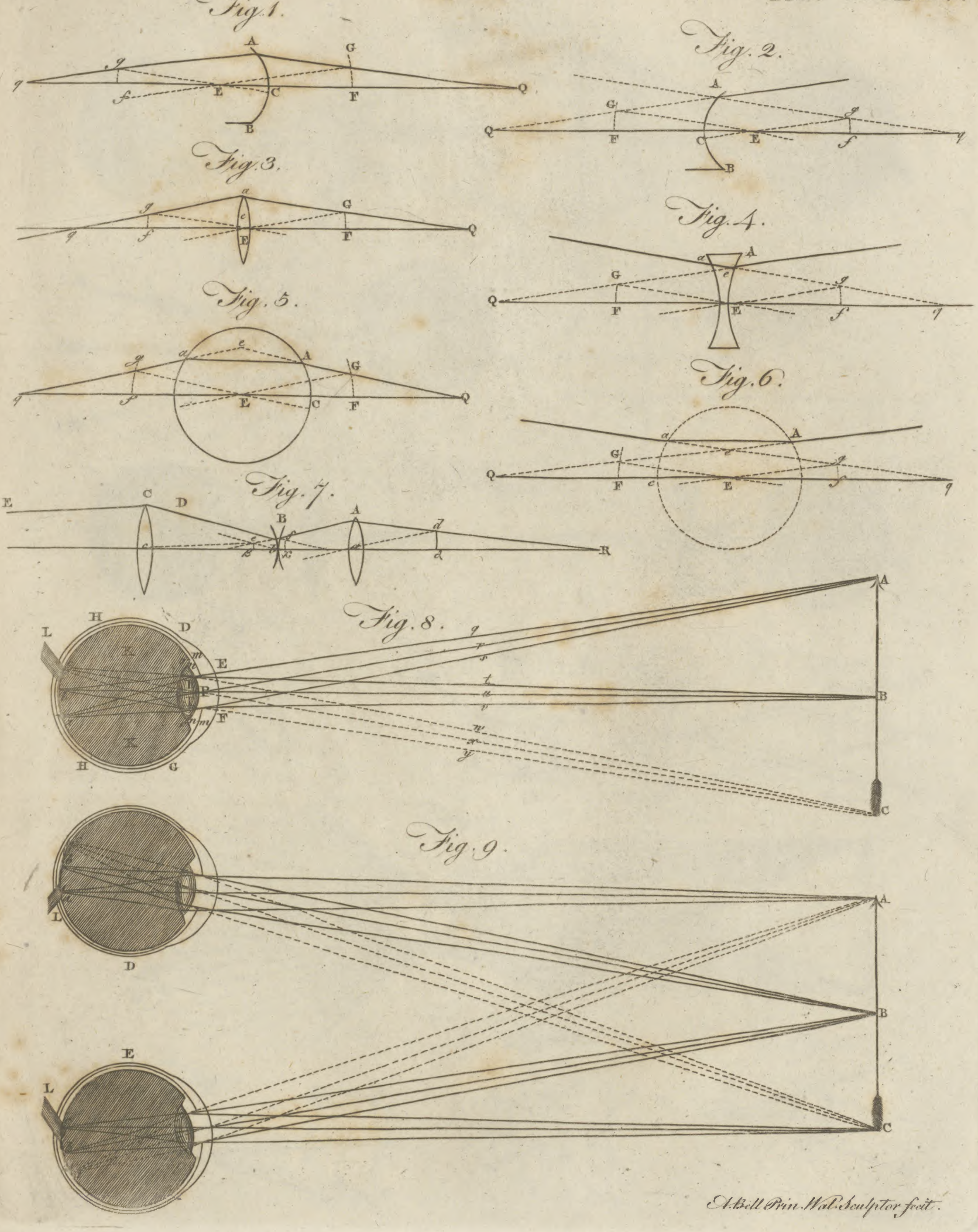

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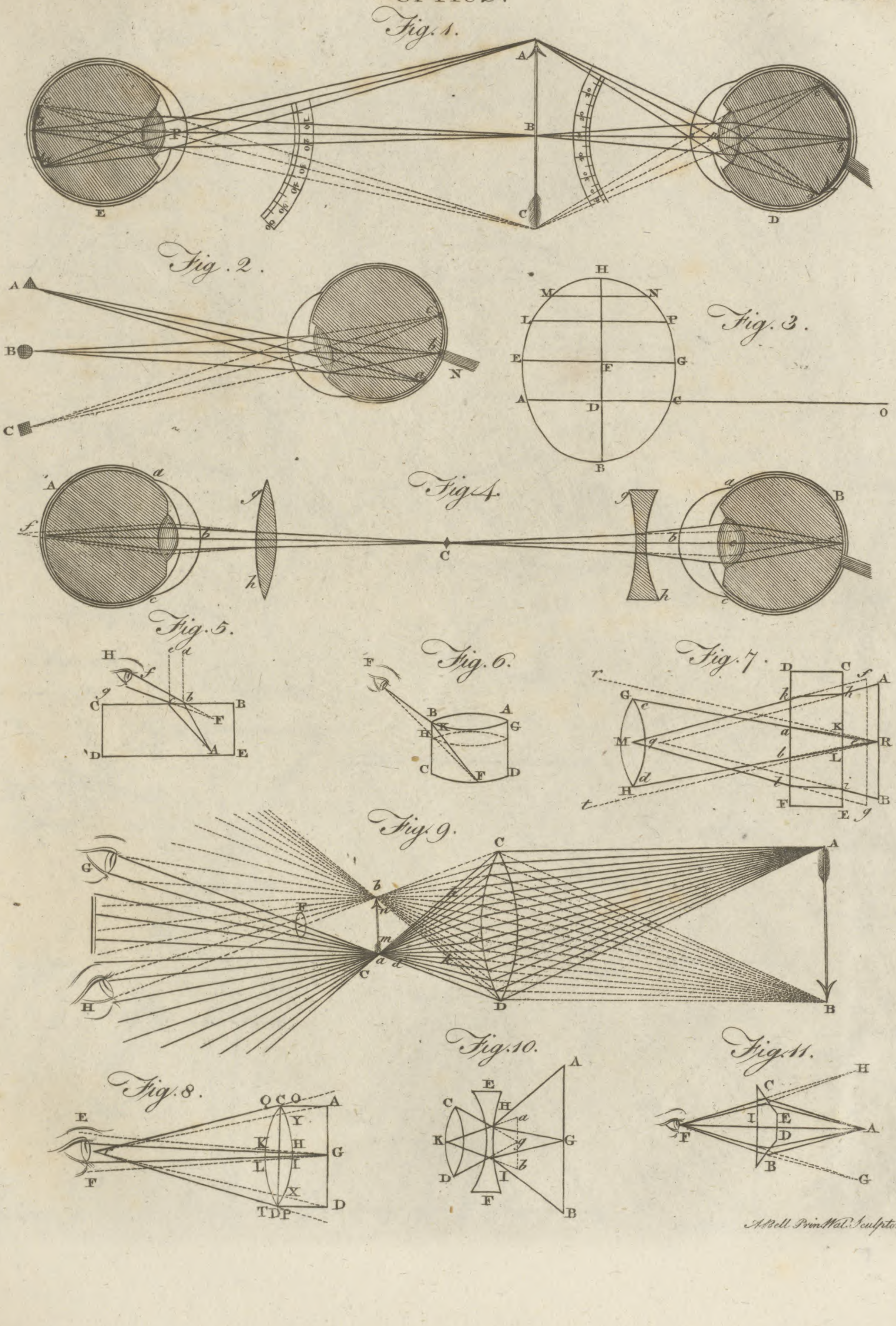

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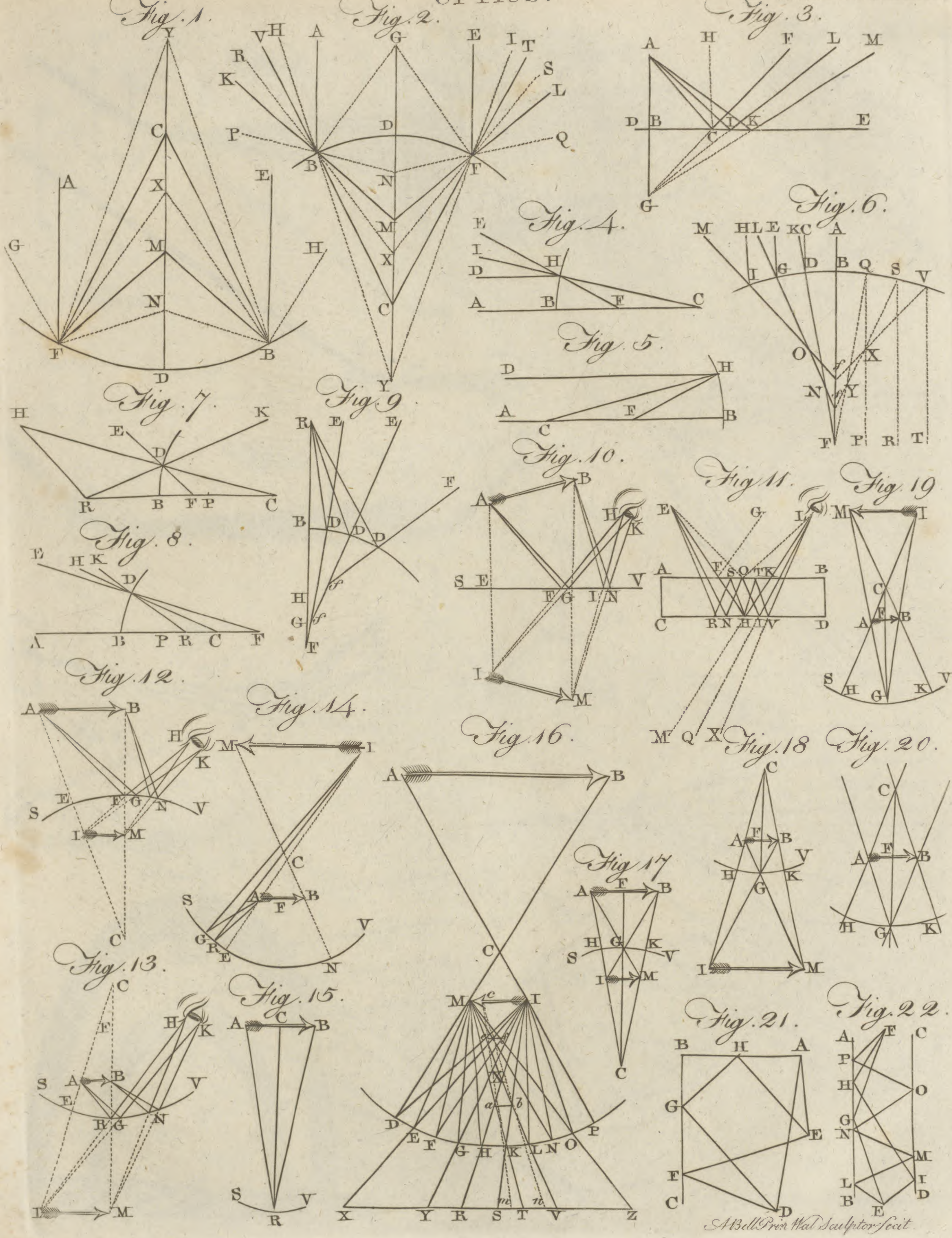
Fig. 1.
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Fig. 10.
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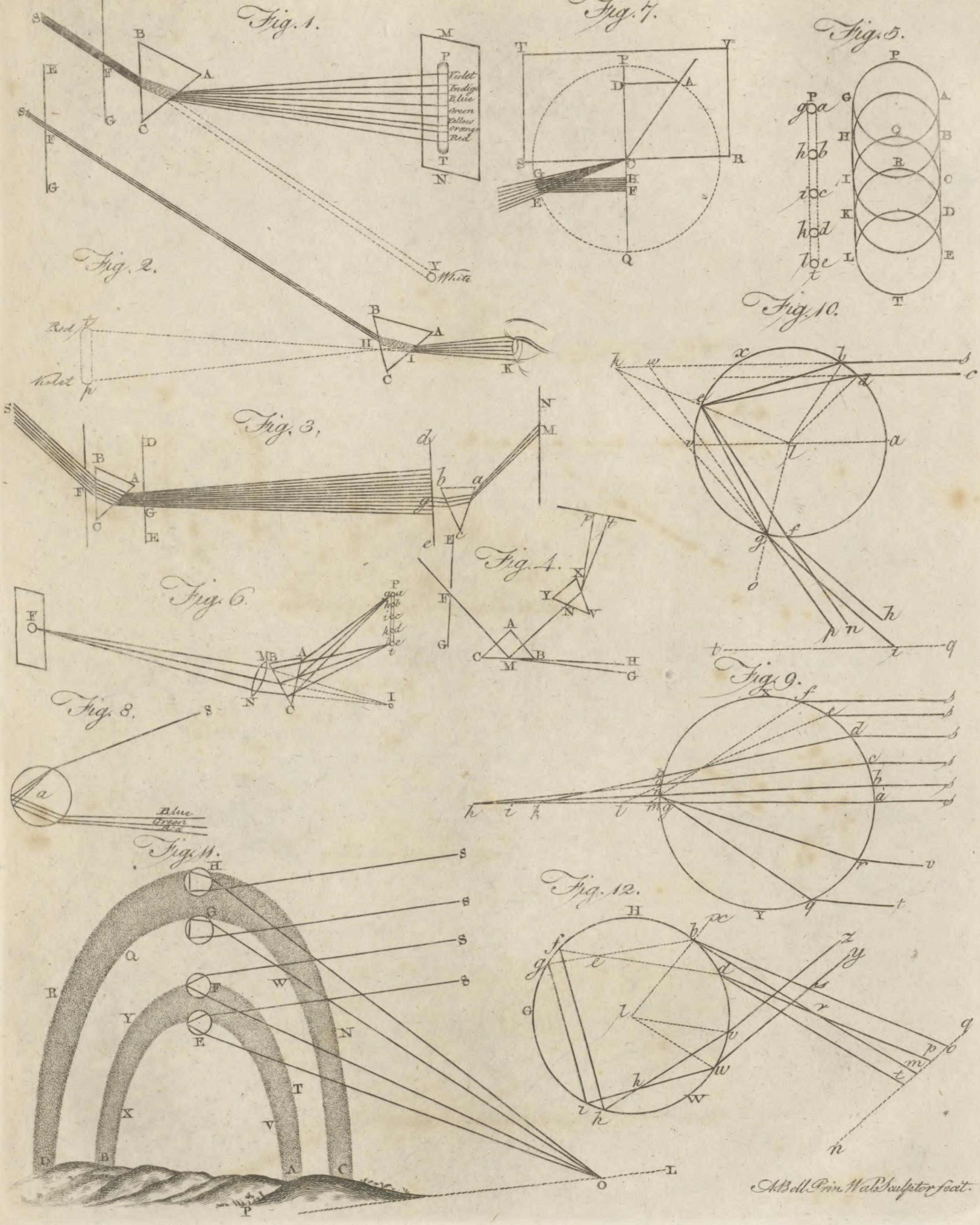
Fig. 21.
Fig. 22.
A Bell Prin Wal Sculptor fecit



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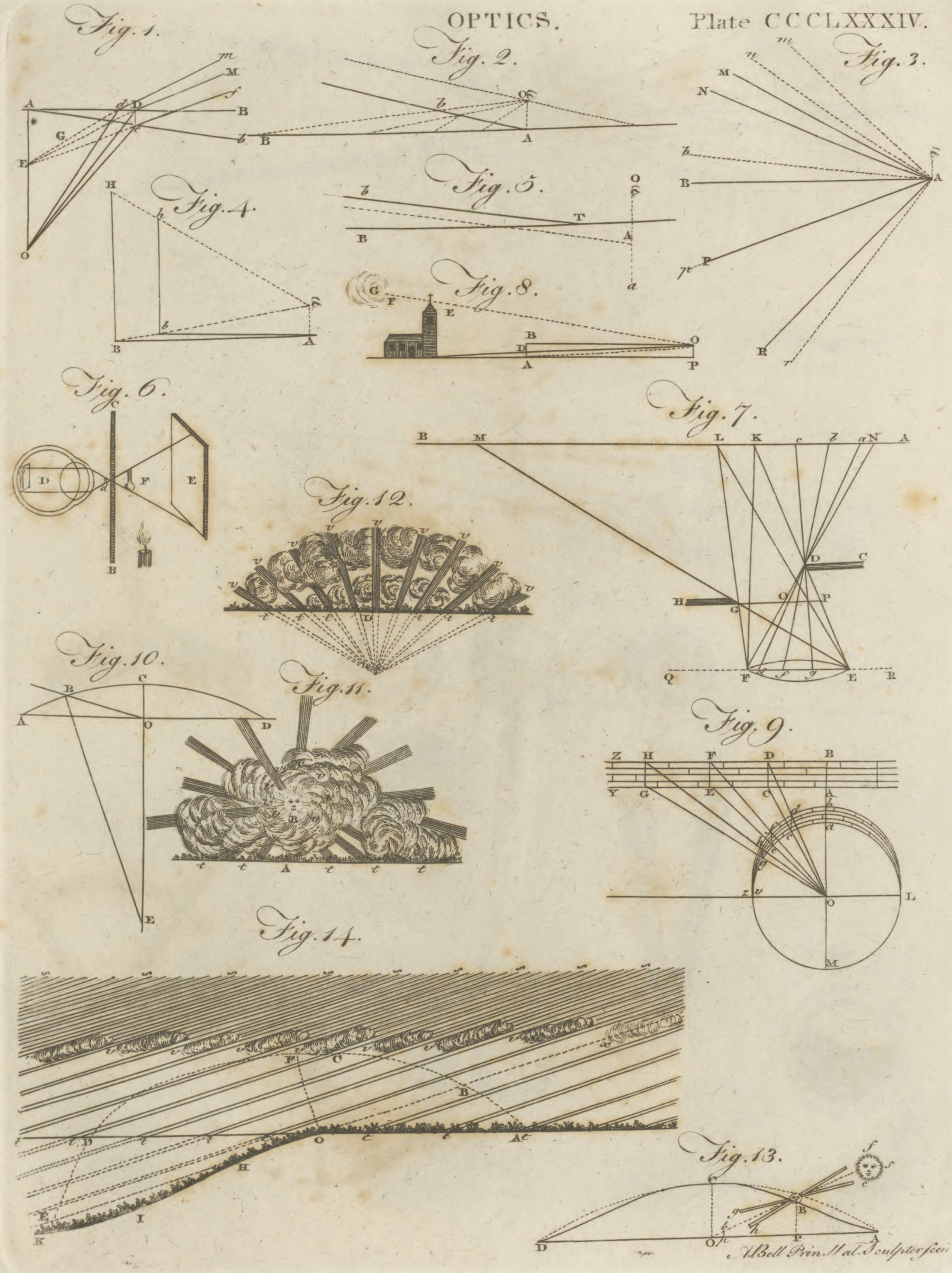
OPTICS. Plate CCCLXXXIV.



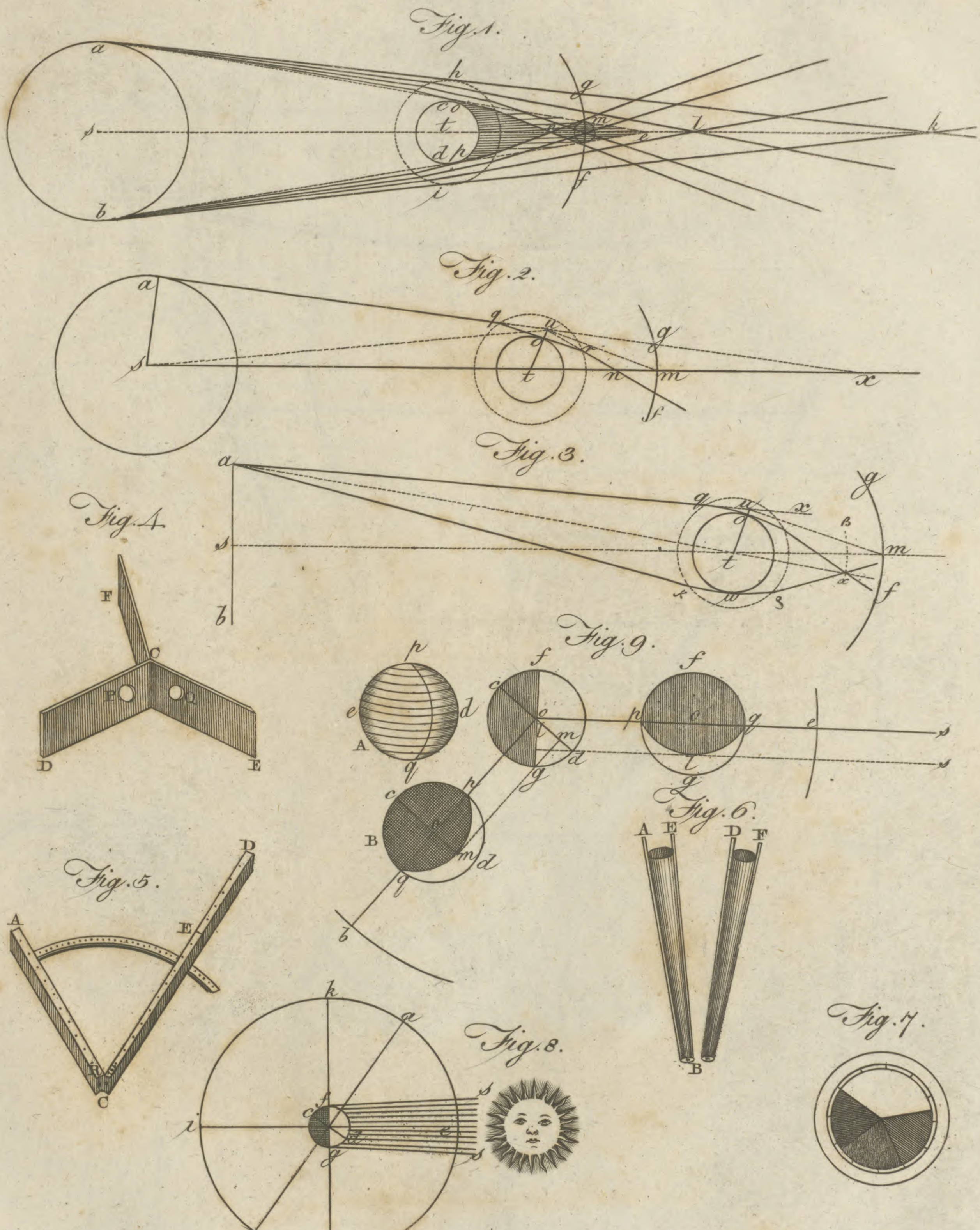


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Fig. 3

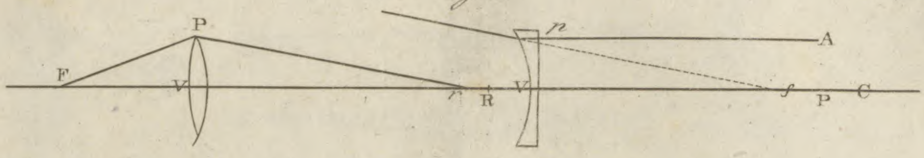

Fig. 2.

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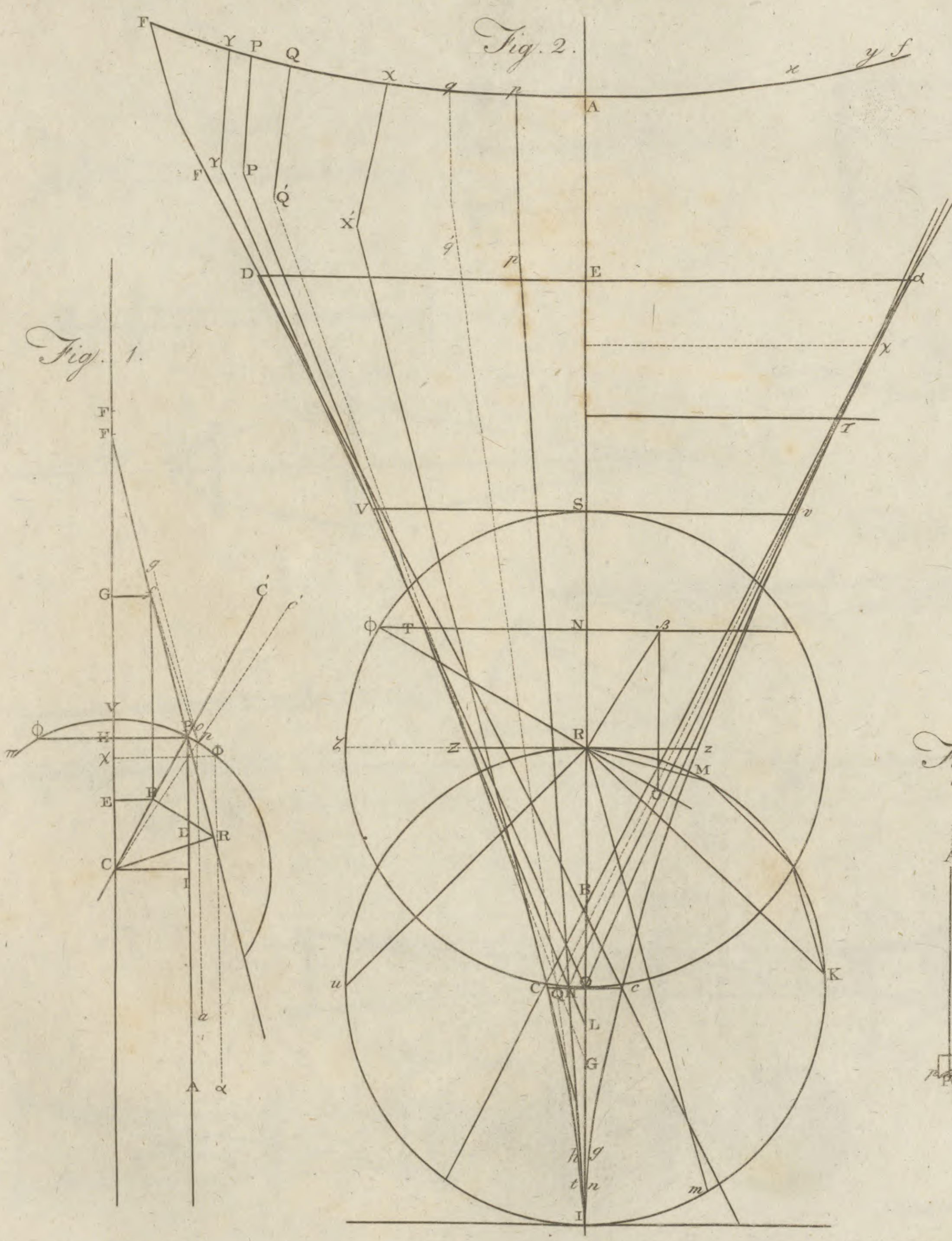
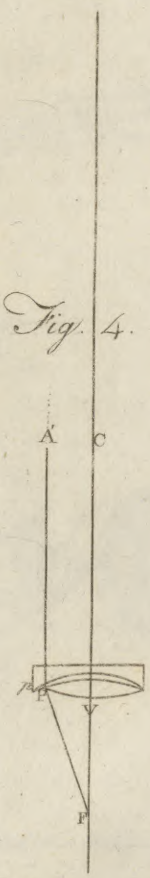


Fig. 4.



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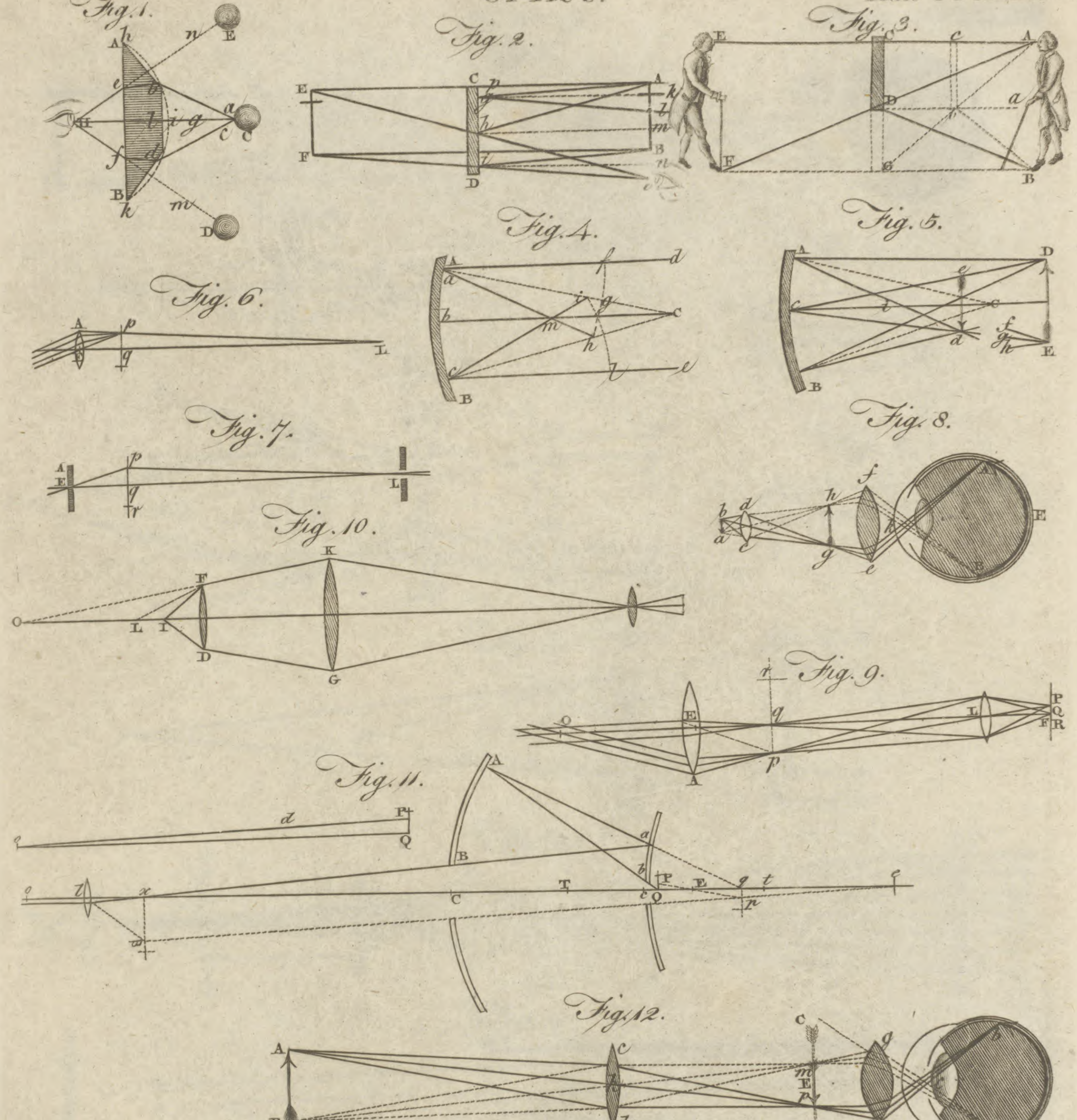

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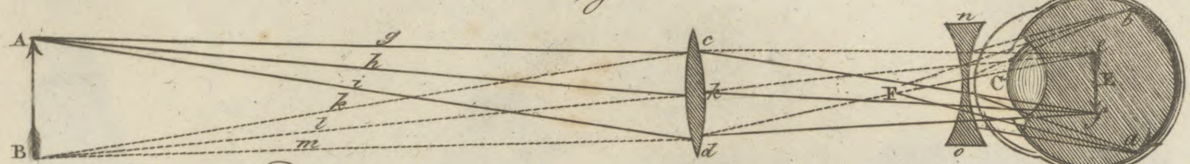
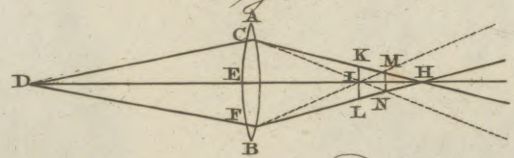


Fig. 2.



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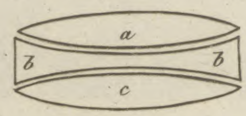

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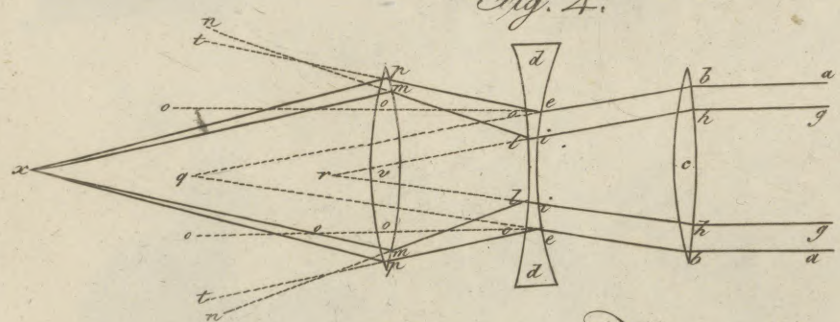

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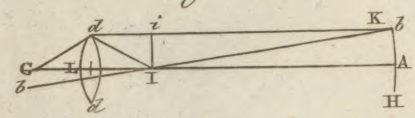

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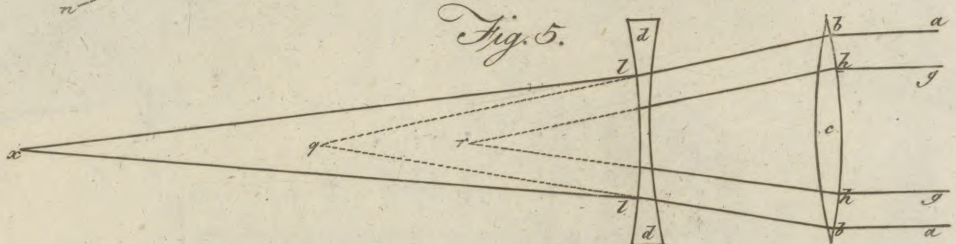

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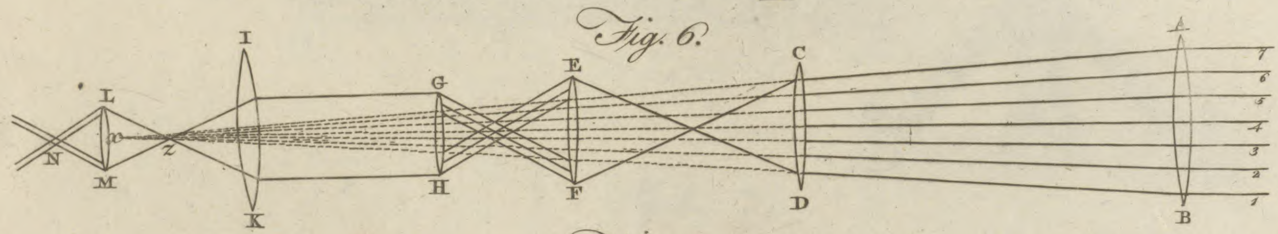

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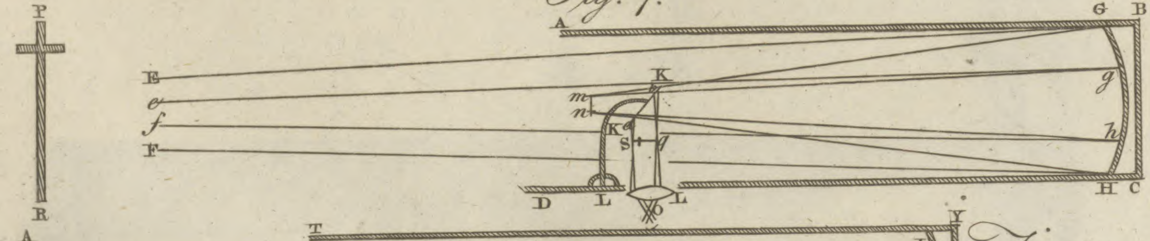

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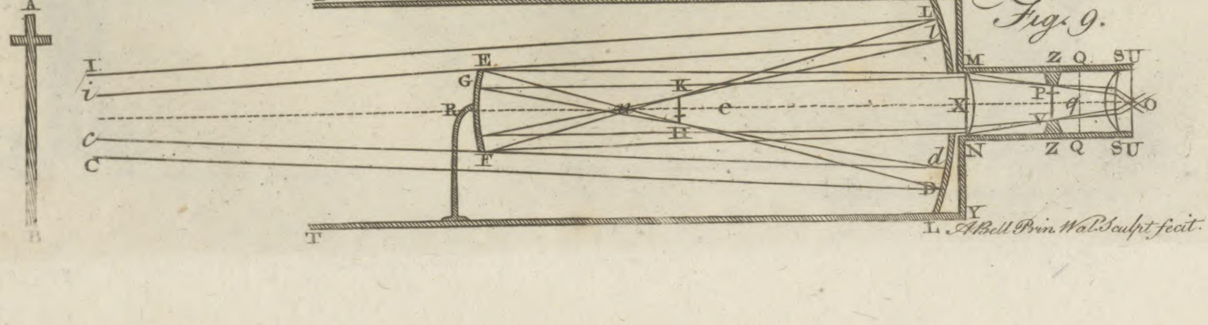

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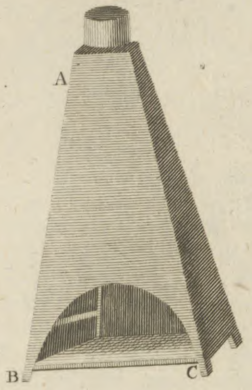
Fig. 1.



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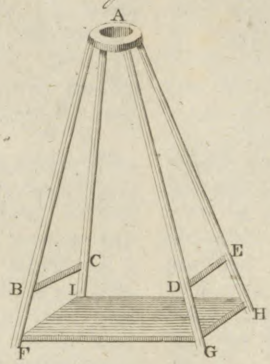

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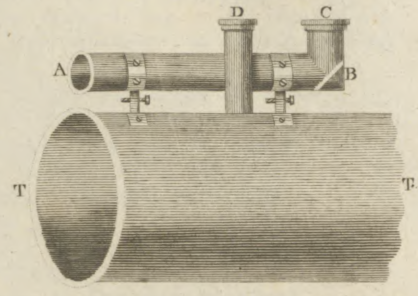

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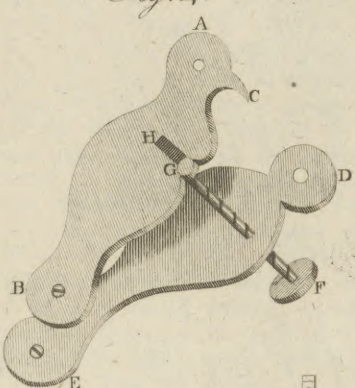
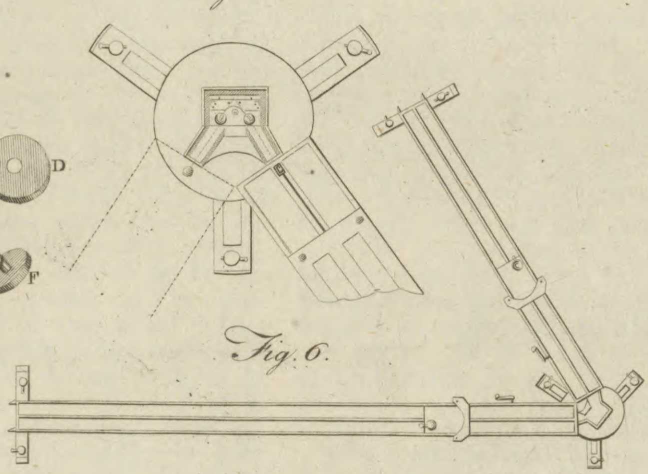


Fig. 5.

Fig. 6.



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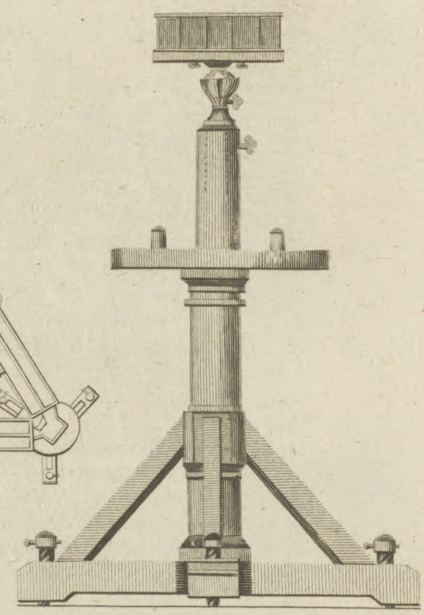

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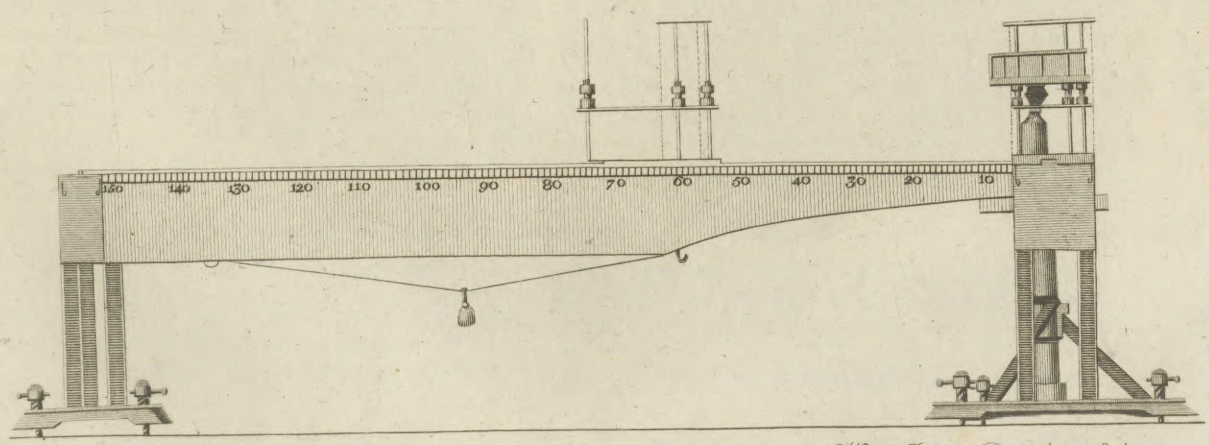

A. Bell Prin. Wal. Sculptor fecit.

Method of grinding and polishing Lenses.

five minutes, be wrought upon the concave one for a few seconds, in order to preserve the same curvature to the tools and the glass. When one side is finished off with the pumice-stone, the lens must be separated from its handle by inserting the point of a knife between it and the pitch, and giving it a gentle stroke. The pitch which remains upon the glass may be removed by rubbing it with a little oil, or spirits of wine; and after the ground side of the glass is fixed upon the handle, the other surface is to be wrought and finished in the very same manner.

281 Mode of polishing.

When the glass is thus brought into its proper form, the next and the most difficult part of the operation is to give it a fine polish. The best, though not the simplest way of doing this, is to cover the concave tool with a layer of pitch, hardened by the addition of a little rosin, to the thickness of one-fifteenth of an inch. Then having taken a piece of thin writing paper, press it upon the surface of the pitch with the convex tool, and pull the paper quickly from the pitch before it has adhered to it; and if the surface of the pitch is marked everywhere with the lines of the paper, it will be truly spherical, having coincided exactly with the surface of the convex tool. If any paper remains on the surface of the pitch, it may be removed by soap and water; and if the marks of the paper should not appear on every part of it, the operation must be repeated till the polisher, or bed of pitch, is accurately spherical. The glass is then to be wrought on the polisher by circular and cross strokes, with the oxide of tin, called the flowers of putty in the shops, or with the red oxide of iron, otherwise called colcothar of vitriol, till it has received on both sides a complete polish (C). The polishing will advance slowly at first, but will proceed rapidly when the polisher becomes warm with the friction. When it is nearly finished, no more putty or water should be put upon the polisher, which should be kept warm by breathing upon it; and if the glass moves with difficulty from its adhesion to the tool, it should be quickly removed, lest it spoil the surface of the pitch. When any particles of dust or pitch insinuate themselves between the glass and the polisher, which may be easily known from the very unpleasant manner of working, they should be carefully removed, by washing both the polisher and the glass, otherwise the lens will be scratched, and the bed of pitch materially injured.

282 By means of pitch.

283 By means of cloth.

The operation of polishing may also be performed by covering the layer of pitch with a piece of cloth, and giving it a spherical form by pressing it with the convex tool when the pitch is warm. The glass is wrought as formerly, upon the surface of the cloth, with putty or colcothar of vitriol, till a sufficient polish is induced. By this mode the operation is slower, and the polish less perfect; though it is best fitted for those who have but little experience, and would therefore be apt to injure the figure of the lens by polishing it on a bed of pitch.

In this manner the small lenses of simple and compound microscopes, the eye-glasses and the object-glasses of telescopes, are to be ground. In grinding concave lenses, Mr Imison * employs leaden wheels with the same radius as the curvature of the lens, and with their circumferences of the same convexity as the lens is to be concave. These spherical zones are fixed upon a turning lathe, and the lens, which is held steadily in the hand, is ground upon them with emery, while they are revolving on the spindle of the lathe. In the same way convex lenses may be ground and polished, by fixing the concave tool upon the lathe; but these methods, however simple and expeditious they may be, should never be adopted for forming the lenses of optical instruments, where an accurate spherical figure is indispensable. It is by the hand alone that we can perform with accuracy those circular and transverse strokes, the proper union of which is essential to the production of a spherical surface. Appendix to Ferguson's Lectures, vol. ii. p. 452.

* *School of Arts*, part ii. p. 145.

284 Impropriety of grinding, &c. on a lathe.

SECT. II. *On the Method of Casting, Grinding, and Polishing the Specula of Reflecting Telescopes.*

285 Composition of the metal.

THE metals of reflecting telescopes are generally composed of 32 parts of copper, and 15 of grain tin, with the addition of two parts of arsenic, to render the composition more white and compact. The Reverend Mr Edwards found, from a variety of experiments, that if one part of brass, and one of silver, be added to the preceding composition, and only one part of arsenic used, a most excellent metal will be obtained, which is the whitest, hardest, and most reflective, that he ever met with. The superiority of this composition, indeed, has been completely evinced by the excellence of Mr Edwards' telescopes, which excel other reflectors in brightness and distinctness, and show objects in their natural colours. But as metals of this composition are extremely difficult to cast, as well as to grind and polish, it will be better for those who are inexperienced in the art, to employ the composition first mentioned.

286 Method of casting the metal.

After the flasks of sand (D) are prepared, and a mould made for the metal by means of a wooden or metallic pattern, so that its face may be downwards, and a few small holes left in the sand at its back, for the free egress of the included air;—melt the copper in a crucible by itself, and when it is reduced to a fluid state, fuse the tin in a separate crucible, and mix it with the melted copper, by stirring them together with a wooden spatula. The proper quantity of powdered arsenic, wrapt up in a piece of paper, is then to be added, the operator retaining his breath till its noxious fumes are completely dissipated; and when the scoria is removed from the fluid mass, it is to be poured out as quickly as possible into the flasks. As soon as the metal is become solid, remove it from the sand into some hot ashes or coals, for the purpose of annealing

(C) As colcothar of vitriol is obtained by the decomposition of martial vitriol, it sometimes retains a portion of this salt. When this portion of martial vitriol is decomposed by dissolution in water, the yellow ochre which results penetrates the glass, forms an incrustation upon its surface, and gives it a dull and yellowish tinge, which is communicated to the image which it forms.

(D) The finest sand which we have met with in this country, is to be found at Roxburgh castle, in the neighbourhood of Kelso.

Method of grinding and poliſhing Lenſes.

annealing it, and let it remain among them till they are completely cold. The ingate is then to be taken from the metal by means of a file; and the ſurface of the ſpeculum muſt be ground upon a common grindſtone, till all the imperfections and aſperities are taken away. When Mr Edwards' compoſition is employed, the copper and tin ſhould be melted according to the preceding directions, and, when mixed together, ſhould be poured into cold water, which will ſeparate the maſs into a number of ſmall particles. Theſe ſmall pieces of metal are then to be collected and put into the crucible, along with the ſilver and braſs, after they have been melted together in a ſeparate crucible; the proper quantity of arſenic is to be added, and a little powdered roſin thrown into the fluid metal before it is poured into the flaſks.

287 Grinding tools, &c.

When the metal is caſt, and prepared by the common grindſtone for receiving its proper figure, the gages and grinding tools are to be formed in the ſame manner as for convex lenſes, with this difference only, that the radius of the gages muſt always be double the focal length of the ſpeculum. In addition to the convex and concave braſs tools, which ſhould be only a little broader than the metal itſelf, a convex elliptical tool of lead and tin ſhould alſo be formed with the ſame radius, ſo that its tranſverſe may be to its conjugate diameter as 10 to 9, the latter being exactly equal to the diameter of the metal. On this tool the ſpeculum is to be ground with flour emery, in the ſame manner as lenſes, with circular and croſs ſtrokes alternately, till its ſurface is freed from every imperfection, and ground to a ſpherical figure. It is then to be wrought with great circumſpection, on the convex braſs tool, with emery of different degrees of fineneſs, the concave tool being ſometimes ground upon the convex one, to keep them all of the ſame radius; and when every ſcratch and appearance of roughneſs is removed from its ſurface, it will be fit for receiving the final poliſh. Before the ſpeculum is brought to the poliſher, it has been the practice to ſmooth it on a bed of hones, or a convex tool made of common blue hones. This additional tool, indeed, is abſolutely neceſſary, when ſilver and braſs enter into the compoſition of the metal, in order to remove that roughneſs which will always remain after the fineſt emery has been uſed; but when theſe metals are not ingredients in the ſpeculum, there is no occaſion for the bed of hones. Without the intervention of this tool I have finiſhed ſeveral ſpecula, and given them as exquiſite a luſtre as they could poſſibly have received. Mr Edwards does not uſe any braſs tools in his proceſs, but transfers the metal from the elliptical leaden tool to the bed of hones. By this means the operation is ſimplified, but we doubt much if it is, in the leaſt degree, improved. As a bed of hones is more apt to change its form than a tool of braſs, it is certainly of great conſequence that the ſpeculum ſhou'd have as true a figure as poſſible before it is brought to the hones; and we are perſuaded, from experience, that this figure may be better communicated on a braſs tool, which can always be kept at the ſame curvature by its correſponding tool, than on an elliptical block of lead. We are certain, however, that when the ſpeculum is required to be of a determinate focal length, this length will be obtained more preciſely with the braſs tools than without them. But Mr Edwards has obſerved, that theſe tools are not only unneceſſary, but 'really detrimental.' That Mr Edwards found them unneceſſary, we cannot doubt, from the excellence of the ſpecula which he formed without their aſſiſtance; but it ſeems inconceivable how the braſs tools can be in the leaſt degree detrimental. If the mirror is ground upon 20 different tools before it is brought to the bed of hones, it will receive from the laſt of theſe tools a certain figure, which it would have received even if it had not been ground on any of the reſt; and it cannot be queſtioned, that a metal wrought upon a pair of braſs tools, is equally, if not more, fit for the bed of hones, than if it had been ground merely on a tool of lead.

288 Method of poliſhing the metal.

When the metal is ready for poliſhing, the elliptical leaden tool is to be covered with black pitch, about one-twentieth of an inch thick, and the poliſher formed in the ſame way as in the caſe of lenſes, either with the concave braſs tool, or with the metal itſelf. The colcothar of vitriol ſhould then be triturated between two ſurfaces of glaſs, and a conſiderable quantity of it applied at firſt to the ſurface of the poliſher. The ſpeculum is then to be wrought in the uſual way upon the poliſhing tool till it has received a brilliant luſtre, taking care to uſe no more of the colcothar, if it can be avoided, and only a ſmall quantity of it, if it ſhould be found neceſſary. When the metal moves ſtiffly on the poliſher, and the colcothar aſſumes a dark muddy hue, the poliſh advances with great rapidity. The tool will then grow warm, and would probably ſtick to the ſpeculum, if its motion were diſcontinued for a moment. At this ſtage of the proceſs, therefore, we muſt proceed with great caution, breathing continually on the poliſher, till the friction is ſo great as to retard the motion of the ſpeculum. When this happens, the metal is to be ſlipped off the tool at one ſide, cleaned with ſoft leather, and placed in a tube for the purpoſe of trying its performance; and if the poliſhing has been conducted with care, it will be found to have a true *parabolic* figure. Appendix to Ferguſon's Lectures, vol. ii. p. 457.

INDEX.

A

Optimates, Optio.

OPTIMATES, one of the diviſions of the Roman people, oppoſed to *populares*. It is not eaſy to aſcertain the characteriſtic differences betwixt theſe two parties. Some ſay the optimates were warm ſupporters of the dignity of the chief magiſtrate, and promoters of the grandeur of the ſtate, who cared not if the inferior members ſuffered, provided the commanding powers were advanced: Whereas the populares boldly ſtood up for the rights of the people, pleaded for larger privileges, and laboured to bring matters nearer to a level. In ſhort, they reſembled, according to this account, the court and country parties amongſt the people of this iſland.

Tully ſays, that the optimates were the beſt citizens, who wiſhed to deſerve the approbation of the better ſort; and that the populares courted the favour of the populace, not ſo much conſidering what was right, as what would pleaſe the people and gratify their own thirſt of vain glory and empty applauſe.

OPTIO, an officer in the Roman army, being an aſſiſtant or lieutenant to every centurion. The *optio* was ſo called becauſe he was the choice or option of the centurion in later times; at firſt, however, he had been choſen by the tribune, or chief commander of the legion. Theſe *optiones* are alſo ſometimes called *ſuccenturiones* and *tergiductores*; the laſt name was given them becauſe their poſt was in the rear of the company. Some authors make mention of *ſub-optiones* or ſub-lieutenants. Option.

It is proper, however, to add, that optiones were not peculiar to the camp, but were alſo uſed in a variety of other offices of life.

OPTION, the power or faculty of wiſhing, or chooſing; or the choice a perſon makes of any thing.

When a new ſuffragan biſhop is conſecrated, the archbiſhop of the province, by a cuſtomary prerogative, claims the collation of the firſt vacant benefice, or dignity, in that ſee, according as he ſhall chooſe; which choice is called the archbiſhop's *option*.

But in caſe the biſhop dies, or is tranſlated, before the

the preſent incumbent of the promotion choſen by the archbiſhop ſhall die or be removed, it is generally ſuppoſed that the option is void; inaſmuch as the granter, ſingly and by himſelf, could not convey any right or title beyond the term of his continuance in that ſee. And if the archbiſhop dies before the avoidance ſhall happen, the right of filling up the vacancy ſhall go to his executors or adminiſtrators.

OPUNTIA, a ſpecies of cactus. See CACTUS, BOTANY *Index*.

OR, the French word for gold, by which this metal is expreſſed in heraldry. In engraving it is denoted by ſmall points all over the field or bearing. It may be ſuppoſed to ſignify of itſelf, *generoſity*, *ſplendour*, or *ſolidity*; according to G. Leigh, if it is compounded with

Gul.	it ſignifies	Courage.
Azu.		Truſt.
Vor.		Joy.
Pur.		Charity.
Sab.		Conſtancy.

ORA, in antiquity, was a term equivalent to an ounce; but it has been much debated among our antiquaries, whether the ora, the mention of which ſo often occurs, was a coin, or only money of account. Dr Hickes obſerves, that the mode of reckoning money by marks and oras was never known in England till after the Daniſh ſettlements; and by examining the old nummulary eſtimates among the principal Gothic ſtates upon the Baltic, it appears, that the ora and ſolidus were ſynonymous terms, and that the ora was the eighth part of the mark. From ſeveral of the Daniſh laws, it likewiſe appears, that the Daniſh ora, derived by corruption from *aureus*, was the ſame as the Frank ſolidus of twelve pence. As a weight, the ora was regarded as the uncia or unit, by which the Daniſh mark was divided; and in Doomſday book the ora is uſed for the ounce, or the twelfth part of the nummulary Saxon pound, and the fifteenth of the commercial: as a coin, it was an aureus, or the Frank ſolidus of twelve pence. And from the accidental coincidence of the Frank aureus with the eighth part of their mark, the Danes probably took occaſion to give it the new name of *ora*. There was another ora mentioned in the rolls of the 27th of Henry III. the value of which was ſixteen pence; and this was probably derived from the half mancus of the Saxons. Such, in all appearance, was the original of theſe two oras; as there were no aurei of that period, to which theſe two denominations of money of ſixteen and twelve pence can poſſibly be aſcribed. It is obſerved farther, that the name *ora* diſtinguiſhes the gold coins in ſeveral parts of Europe to this day. The Portugueſe moidore is nothing elſe but *moeda d'oro*, from the Latin *moneta de auro*; the French *Louis d'ors* come from the ſame uſe of the word, and owe their appellation to the ora. See Clarke on Coins.

ORACH. See ATRIPLEX, BOTANY *Index*.
Wild ORACH. See CHENOPODIUM. BOTANY *Index*.

ORACLE, among the heathens, was the anſwer which the gods were ſuppoſed to give to thoſe who conſulted them upon any affair of importance. It is alſo uſed for the god who was thought to give the anſwer, and for the place where it was given.

The credit of oracles was ſo great, that in all doubts and diſputes their determinations were held ſacred and inviolable: whence vaſt numbers flocked to them for advice about the management of their affairs; and no buſineſs of any conſequence was undertaken, ſcarce any peace concluded, any war waged, or any new form of government inſtituted, without the advice and approbation of ſome oracle. The anſwers were uſually given by the intervention of the prieſt or prieſteſs of the god who was conſulted; and generally expreſſed in ſuch dark and unintelligible phraſes, as might be eaſily wreſted to prove the truth of the oracle whatever was the event. It is not, therefore, to be wondered at, that the prieſts who delivered them were in the higheſt credit and eſteem, and that they managed this reputation ſo as greatly to promote their own particular advantage. They accordingly allowed no man to conſult the gods, before he had offered coſtly ſacrifices, and made rich preſents to them. And to keep up the veneration for their oracles, and to prevent their being taken unprepared, they admitted perſons to conſult the gods only at certain ſtated times; and ſometimes they were ſo cautious, that the greateſt perſonages could obtain no anſwer at all. Thus Alexander himſelf was peremptorily denied by the Pythia, or prieſteſs of Apollo, till ſhe was by downright force obliged to aſcend the tripos; when, being unable to reſiſt any longer, ſhe cried out, *Thou art invincible:* and theſe words were accepted inſtead of a farther oracle.

Of the ambiguity of oracles, the following, out of a great many examples, may be mentioned. Crœſus having received from the Pythoneſs this anſwer, That by paſſing the river Halys, he would deſtroy a great empire; he underſtood it to be the empire of his enemy, whereas he deſtroyed his own.—The oracle conſulted by Pyrrhus gave him an anſwer, which might be equally underſtood of the victory of Pyrrhus, and the victory of the Romans his enemies:

Aio te, Æacida, Romanos vincere poſſe.

The equivocation lies in the conſtruction of the Latin tongue, which cannot be rendered in Engliſh.—The Pythoneſs adviſed Crœſus to guard againſt the mule. The king of Lydia underſtood nothing of the oracle, which denoted Cyrus deſcended from two different nations; from the Medes, by Mandana his mother, the daughter of Aſtyages; and from the Perſians, by his father Cambyſes, whoſe race was by far leſs grand and illuſtrious.—Nero had for anſwer, from the oracle of Delphos, that ſeventy-three might prove fatal to him. He believed he was ſafe from all danger till that age; but, finding himſelf deſerted by every one, and hearing Galba proclaimed emperor, who was 73 years of age, he was ſenſible of the deceit of the oracle.

When men began to be better inſtructed by the lights philoſophy had introduced into the world, the falſe oracles inſenſibly loſt their credit. Chryſippus filled an entire volume with falſe or doubtful oracles. Oenomaus, to be revenged of ſome oracle that had deceived him, made a compilation of oracles, to ſhow their ridiculous vanity. Euſebius has preſerved ſome fragments of this criticiſm on oracles by Oenomaus. "I might (ſays Origen) have recourſe to the authority of Ariſtotle and the Peripatetics, to make the Pythoneſs much ſuſpected: I might extract from the writings

Oracle. writings of Epicurus and his sectators an abundance of things to discredit oracles; and I might shew that the Greeks themselves made no great account of them."

The reputation of oracles was greatly lessened when they became an artifice of politics. Themistocles, with a design of engaging the Athenians to quit Athens, and to embark, in order to be in a better condition to resist Xerxes, made the Pythoness deliver an oracle, commanding them to take refuge in wooden walls. Demosthenes said, that the Pythoness *Philippized;* to signify that she was gained over by Philip's presents.

The cessation of oracles is attested by several profane authors; as Strabo, Juvenal, Lucan, and others. Plutarch accounts for it, by saying, that the benefits of the gods are not eternal as themselves are; or that the genii, who presided over oracles, are subject to death; or that the exhalations of the earth had been exhausted. It appears that the last reason had been alleged in the time of Cicero, who ridicules it in his second book of Divination, as if the spirit of prophecy, supposed to be excited by subterraneous effluvia, had evaporated by length of time, as wine or pickle by being long kept.

Suidas, Nicephorus, and Cedrenus, relate, that Augustus, having consulted the oracle of Delphos, could obtain no other answer but this: "The Hebrew child whom all the gods obey, drives me hence, and sends me back to hell: get out of this temple without speaking one word." Suidas adds, that Augustus dedicated an altar in the Capitol, with this inscription, "To the eldest Son of God." Notwithstanding these testimonies, the answer of the oracle of Delphos to Augustus seems very suspicious. Cedrenus cites Eusebius for this oracle, which is not now found in his works; and Augustus's peregrination into Greece was 18 years before the birth of Christ.

Suidas and Cedrenus give an account also of an ancient oracle delivered to Thulis, a king of Egypt, which they say is well authenticated. The king having consulted the oracle of Serapis, to know if there ever was, or would be, one so great as himself, received this answer: First, God, next the Word, and the Spirit with them. They are equally eternal, and make but one, whose power will never end. But thou, mortal, go hence, and think that the end of the life of man is uncertain."

Van Dale, in his treatise of oracles, does not believe that they ceased at the coming of Christ. He relates several examples of oracles consulted till the death of Theodosius the Great. He quotes the laws of the emperors Theodosius, Gratian, and Valentinian, against those who consulted oracles, as a certain proof that the superstition of oracles still subsisted in the time of those emperors.

According to others, the opinion of those who believe that demons had no share in the oracles, and that the coming of the Messiah made no change in them, and the contrary opinion of those who pretend that the incarnation of the Word imposed a general silence on all oracles, should be equally rejected. They allege, that two sorts of oracles ought to be distinguished: the one dictated by the spirits of darkness, who deceived men by their obscure and doubtful answers; the other, the pure artifice and cheat of the priests of false divinities. As to the oracles given out by demons, the reign of Satan was destroyed by the coming of the Saviour; truth shut the mouth of lies; but Satan continued his old craft among idolaters. All the devils were not forced to silence at the same time by the coming of the Messiah; it was on particular occasions that the truth of Christianity, and the virtue of Christians, imposed silence on the devils. St Athanasius tells the Pagans, that they have been witnesses themselves that the sign of the cross puts the devils to flight, silences oracles, and dissipates enchantments. This power of silencing oracles, and putting the devils to flight, is also attested by Arnobius, Lactantius, Prudentius, Minutius Felix, and several others. Their testimony is a certain proof that the coming of the Messiah had not imposed a general silence on oracles.

Plutarch relates, that the pilot Thamus heard a voice in the air, crying out, "The great Pan is dead;" whereupon Eusebius observes, that the accounts of the death of the demons were frequent in the reign of Tiberius, when Christ drove out the wicked spirits.

The same judgement, it is said, may be passed on oracles as on *possessions*. It was on particular occasions, by the divine permission, that the Christians cast out devils, or silenced oracles, in the presence, and even by the confession, of the Pagans themselves. And thus it is we should, it seems, understand the passages of St Jerome, Eusebius, Cyril, Theodoret, Prudentius, and other authors, who said that the coming of Christ had imposed silence on the oracles.

As to the second sort of oracles, which were pure artifices and cheats of the priests of false divinities, and which probably exceeded the number of those that immediately proceeded from demons, they did not cease till idolatry was abolished, though they had lost their credit for a considerable time before the coming of Christ. It was concerning this more common and general sort of oracles that Minutius Felix said, they began to discontinue their responses, according as men began to be more polite. But, however oracles were decried, impostors always found dupes, the grossest cheats having never failed.

Daniel discovered the imposture of the priests of Bel, who had a private way of getting into the temple to take away the offered meats, and who made the king believe that the idol consumed them.—Mundus, being in love with Paulina, the eldest of the priestesses of Isis, went and told her, that the god Anubis, being passionately fond of her, commanded her to give him a meeting. She was afterwards shut up in a dark room, where her lover Mundus, whom she believed to be the god Anubis, was concealed. This imposture having been discovered, Tiberius ordered those detestable priests and priestesses to be crucified, and with them Idæa, Mundus's free woman, who had conducted the whole intrigue. He also commanded the temple of Isis to be levelled with the ground, and her statue to be thrown into the Tiber; and, as to Mundus, he contented himself with sending him into banishment.

Theophilus, bishop of Alexandria, not only destroyed the temples of the false gods, but discovered the cheats of the priests, by showing that the statues, some of which were of brass, and others of wood, were hollow within, and led into dark passages made in the wall.

 Lucian,

Oracle.

Lucian, in diſcovering the impoſtures of the falſe prophet Alexander, ſays, that the oracles were chiefly afraid of the ſubtilties of the Epicureans and Chriſtians. The falſe prophet Alexander ſometimes feigned himſelf ſeized with a divine fury, and by means of the herb ſopewort, which he chewed, frothed at the mouth in ſo extraordinary a manner, that the ignorant people attributed it to the ſtrength of the god he was poſſeſſed by. He had long before prepared a head of a dragon made of linen, which opened and ſhut its mouth by means of a horſe hair. He went by night to a place where the foundations of a temple were digging: and having found water, either of a ſpring, or rain that had ſettled there, he hid in it a gooſe egg, in which he had encloſed a little ſerpent that had been juſt hatched. The next day, very early in the morning, he came quite naked into the ſtreet, having only a ſcarf about his middle, holding in his hand a ſcythe, and toſſing about his hair as the prieſts of Cybele; then getting a-top of a high altar, he ſaid, that the place was happy to be honoured by the birth of a god.—Afterwards, running down to the place where he had hid the gooſe egg, and going into the water, he began to ſing the praiſes of Apollo and Æſculapius, and to invite the latter to come and ſhow himſelf to men. With theſe words, he dips a bowl into the water, and takes out the myſterious egg, which had a god encloſed in it; and when he had it in his hand, he began to ſay that he held Æſculapius. Whilſt all were eager to have a ſight of this fine myſtery, he broke the egg, and the little ſerpent ſtarting out, twiſted itſelf about his fingers.

Theſe examples ſhow clearly, that both Chriſtians and Pagans were ſo far agreed as to treat the *greater number* of oracles as purely human impoſtures. That, in fact, ALL of them were ſo, will be concluded by thoſe who give equal credit to demoniacal *inſpiration*, and demoniacal *poſſeſſion*. The moſt ancient oracle was that of Dodona (ſee DODONA); but the moſt famous was that of Delphi, to which article we alſo refer for further particulars on this ſubject, ſo famous in Pagan antiquity. Another celebrated one was the oracle of Trophonius, in the neighbourhood of Lebadia, a city of Bœotia, which was held in high eſtimation. It received its name from Trophonius, brother of Agamedes, who lived in a ſubterraneous dwelling near Lebadia, and pretended to the faculty of foretelling future events. He died in his cave, and was deified as an oracular god. This oracle owed its reputation to one Saon.

Thoſe who repaired to this cave for information, were required to offer certain ſacrifices, to anoint themſelves with oil, and to bathe in a certain river: They were then clothed in a linen robe, took a honeyed cake in their hands, and deſcended into the ſubterraneous chamber by a narrow paſſage. Here it was that futurity was unfolded to them, either by viſions or extraordinary ſounds. The return from the cave was by the ſame paſſage, but the perſons conſulting were obliged to walk backwards. They generally came out aſtoniſhed, melancholy, and dejected; hence the proverb εις Τροφωνιου μεμαντευται. The prieſts on their return placed them on an elevated ſeat, called *the ſeat of Mnemoſyne*, where an account was taken of what they had ſeen and heard. They were then conducted to the chapel of good Genius by their companions, where, by degrees, they recovered their uſual compoſure and cheerfulneſs.

Beſides theſe three principal oracles of Greece, it is proper to take notice of that of Amphiaraus at Oropius in Attica. It was ſo called from Amphiaraus, the ſon of Oicleus, a man ſkilled in magic, the interpretation of dreams, &c. and who after his death was deified and delivered oracles in a temple erected to his divinity. (See AMPHIARAUS). They who applied to them for information, were to purify themſelves, offer ſacrifice, faſt twenty-four hours, abſtain from wine two days, and make an offering of a ram to Amphiaraus; on the ſkin of which they were to ſleep, and ſee their deſtiny in a dream. Near the temple was Amphiaraus's fountain, which was ſacred, and the waters of it forbidden to be uſed for ordinary purpoſes.

At Delos alſo there was an oracle of the Delian Apollo; in Mileſia was that of the Branchidæ, with others of leſs note, which require not a particular deſcription, ſuch as that of the camps at Lacedæmon, that of Nabarcha, that of Chryſopolis, that of Clares in Ionia, that of Mallos, that of Patarca, that of Pella, that of Phaſellides, that of Sinope, that of Orpheus's head, &c.

Though the Romans conſulted the Grecian oracles upon many occaſions, and had few oracles in their own country; yet we muſt not omit mentioning the Cumæan oracles, which were delivered by the Sibyl of Cumæ. For an account of the Sibyls, ſee the article SIBYL. See alſo DÆMON and DÆMONIAC.

We have hitherto only conſidered the oracles of falſe gods, of which there was a far greater number than our limits permit us to obſerve, and before either Greeks or Romans had riſen to any diſtinction. Oracle is in ſacred hiſtory ſometimes uſed for the mercy ſeat, or the cover of the ark of the covenant; and by others it is taken for the ſanctuary, or for the moſt holy place, wherein the ark was depoſited.

Among the Jews we may diſtinguiſh ſeveral ſorts of *real* oracles. They had firſt oracles that were delivered *viva voce;* as when God ſpake to Moſes face to face, and as one friend ſpeaks to another, (Numb. xii. 8.). Secondly, Prophetical dreams ſent by God; as the dreams which God ſent to Joſeph, and which foretold his future greatneſs. (Gen. xxxvii. 5, 6.). Thirdly, Viſions; as when a prophet in an ecſtaſy, being neither properly aſleep nor awake, had ſupernatural revelations, (Gen. xv. 1. xlvi. 2.). Fourthly, The oracle of Urim and Thummim, which was accompanied with the ephod or the pectoral worn by the high prieſt, and which God had endued with the gift of foretelling things to come, (Numb. xii 6. Joel. ii. 28.). This manner of inquiring of the Lord was often made uſe of, from Joſhua's time to the erection of the temple at Jeruſalem. Fifthly, After the building of the temple, they generally conſulted the prophets, who were frequent in the kingdoms of Judah and Iſrael. From Haggai, Zechariah, and Malachi, who are the laſt of the prophets that have any of their writings remaining, the Jews pretend that God gave them what they call *Bathcol*, the daughter of the voice, which was a ſupernatural manifeſtation of the will of God, which was performed either by a ſtrong inſpiration or internal voice, or elſe by a ſenſible

and

and external voice, which was heard by a number of persons sufficient to bear testimony of it. For example, such was the voice that was heard at the baptism of Jesus Christ, saying, This is my beloved Son, &c. (Matth. iii. 17.).

The Scripture affords us examples likewise of profane oracles. Balaam, at the instigation of his own spirit, and urged on by his avarice, fearing to lose the recompense that he was promised by Balak king of the Moabites, suggests a diabolical expedient to this prince, of making the Israelites fall into idolatry and fornication (Numb. xxiv. 14. xxxi. 16.), by which he assures him of a certain victory, or at least of considerable advantage against the people of God.

Micaiah the son of Imlah, a prophet of the Lord, says (1 Kings xxii. 21, &c.), that he saw the Almighty sitting upon his throne, and all the host of heaven round about him; and the Lord said, who shall tempt Ahab king of Israel, that he may go to war with Ramoth-gilead, and fall in the battle? One answered after one manner, and another in another. At the same time an evil spirit presented himself before the Lord, and said, I will seduce him. And the Lord asked him, How? To which Satan answered, I will go and be a lying spirit in the mouth of his prophets. And the Lord said, Go and thou shalt prevail. This dialogue clearly proves these two things: *first*, that the devil could do nothing by his own power; and, *secondly*, that with the permission of God, he could inspire the false prophets, sorcerers, and magicians, and make them deliver false oracles.

Respecting the cessation of profane oracles there have been a variety of opinions; some of which we have already remarked. It has been generally held, indeed, that oracles ceased at the birth of Jesus Christ: Yet some have endeavoured to maintain the contrary, by showing that they were in being in the days of Julian, commonly called *the Apostate*, and that this emperor himself consulted them; nay, farther, say they, history makes mention of several laws published by the Christian emperors Theodosius, Gratian, and Valentinian, to punish persons who interrogated them, even in their days; and that the Epicureans were the first who made a jest of this superstition, and exposed the roguery of its priests to the people. As we suspect most of the facts here asserted should be understood in a qualified sense, we shall endeavour to discuss this point of controversy in as few words as possible, although it is undoubtedly a matter of some consequence.

1st, The question, properly stated, is not, Whether oracles became extinct *immediately upon the birth of Christ*, or from the very moment he was born; but, If they fell gradually into disesteem and ceased, as Christ and his gospel became known to mankind. And that they did so, is most certain from the concurrent testimonies of the fathers, which, whoever would endeavour to invalidate, may equally give up the most respectable traditions and relations of every kind.

2dly, But did not Julian the apostate consult these oracles? We answer in the negative: he had indeed recourse to magical operations, but it was because oracles had already ceased; for he bewailed the loss of them, and assigned pitiful reasons for it; which St Cyril has vigorously refuted, adding, that *he never could have offered such, but from an unwillingness to acknowledge, that when the world had received the light of Christ, the dominion of the devil was at an end.*

3dly, The Christian emperors do indeed seem to condemn the superstition and idolatry of those who were still for consulting oracles; but the edicts of those princes do not prove that oracles actually existed in their times, any more than that they ceased in consequence of their laws. It is certain that they were for the most part extinct before the conversion of Constantine.

4thly, Some Epicureans might *make a jest of this superstition*: however the Epicurean philosopher Celsus, in the second century of the church, was for crying up the excellency of several oracles, as appears at large from Origen's seventh book against him.

ORÆA, certain solemn sacrifices of fruits which were offered in the four seasons of the year, in order to obtain mild and temperate weather. They were offered to the goddesses who presided over the seasons, who attended upon the sun, and who received divine worship at Athens.

ORAL, something delivered by word of mouth, without being committed to writing; in which sense we say oral law, oral tradition, &c.

ORAN, a very strong and important town of Africa, in Barbary, and in the kingdom of Tremecen, with several forts, and an excellent harbour. It is seated partly on the side of a hill, and partly on a plain, about a stonecast from the sea, almost opposite to Carthagena in Spain. It is about a mile and a half in circumference, and well fortified, but commanded by the adjacent hills. It was taken by the Spaniards in 1509, and retaken by the Algerines in 1708; but in 1732 the Spaniards became masters of it, and have continued so ever since. E. Long. 0. 8. N. Lat. 36. 2.

ORANG OUTANG. See SIMIA, MAMMALIA *Index*.

ORANGE, a famous city, and capital of a province of the same name, united to Dauphiny, with a university and a bishop's see, suffragan of Arles. It is seated in a fine large plain, watered by a vast number of little rivulets on the east side of the river Rhone. It is a very large ancient place, and was considerable in the time of the Romans, who adorned it with several buildings, of which there are still some ruins left, particularly of an amphitheatre, and a triumphal arch, which is almost entire, dedicated to Marius. This town was formerly much larger than it is at present, as appears from the traces of the ancient walls. The wall was in 1682 entirely demolished by order of Louis XIV. and the inhabitants were exposed to the fury of the soldiers. The town was restored to King William by the treaty of Ryswick; but after his death the French took it again, and expelled the Protestant inhabitants. By the treaty of Utrecht it was confirmed to the crown of France, though the title is still retained in the house of Nassau. The title was first introduced into the family of Nassau, by the marriage of Claude de Chalons, the prince of Orange's sister, with the count of Nassau, 1530. The principality is a very small district, it being only twelve miles in length and nine in breadth, and the revenue amounts to about 5000l. a-year. The country is pleasant, and abounds with corn and fruit, but is exposed to violent winds. E. Long. 4. 49. N. Lat. 44. 9.

Maurice Prince of ORANGE. See MAURICE.

ORANGE River, also known by the name of the Great

Great river, is situated in southern Africa, and is of considerable extent. It seems to take its rise about S. Lat. 30°, and E. Long. 28° from Greenwich, and joins the sea, after a west by north course for a number of leagues, between the great and little Namaquas, two tribes supposed to be of the same origin with the Hottentots. There are high cataracts in it, and it is subject to inundations like the Nile. Carnelians, calcedonies, agates and variolites are found upon the shores. The rains in the great mountains along the foot of which the Orange river runs, collecting their streams in its passage, commence in the month of November, and cause the inundations to take place towards the Namaqua country in the month of December. The nauseous custom of greasing the skin, from the great scarcity of water in many parts of South Africa, is rendered unnecessary among the people who inhabit the banks of this grand river; and of consequence they exhibit none of that filthy appearance which is characteristic of the Hottentots on the skirts of the colony.

ORANGE-Tree, in *Botany*. See CITRUS, BOTANY *Index*.—Orange flowers are justly esteemed one of the finest perfumes; and though little used in medicine, yet the water distilled from them is accounted stomachic, cordial, and carminative. The fruit is cooling, and good in feverish disorders, and particularly in diarrhœas. Orange-peel is an agreeable aromatic, proper to repair and strengthen the stomach, and gives a very grateful flavour to any infusions or tinctures into whose compositions it enters. It is particularly useful in preparations of the bark: gives an agreeable warmth to the infusion; and, according to Dr Percival, considerably increases its virtue.

In the Philosophical Transactions, N° 114. there is a very remarkable account of a tree standing in a grove near Florence, having an *orange* stock, which had been so grafted upon, that it became in its branches, leaves, flowers, and fruit, three-formed: some emulating the orange, some the lemon or citron, and some partaking of both forms in one; and what was very remarkable, was, that these mixed fruits never produced any perfect seeds: sometimes there were no seeds at all in them, and sometimes only a few empty ones.

ORANGE-Dew, a kind of dew which falls in the spring time from the leaves of orange and lemon trees, which is extremely fine and subtile. M. de la Hire observing this, placed some flat pieces of glass under the leaves to receive it: and having procured some large drops of it, was desirous of discovering what it was. He soon found that it was not merely an aqueous fluid, because it did not evaporate in the air; and that it was not a resin, because it readily and perfectly mixed with water: it was natural then to suppose it a liquid gum; but neither did this, on examination, prove to be the case; for being laid on paper, it did not dry as the other liquid gums do. Its answering to none of these characters, and its being of the consistence of honey, and of a sweet sugar-like taste, gave a suspicion of its being a kind of manna; and whatever in the other trials had proved it not a resin, a gum, &c. all equally tends to prove that it is this substance.

ORANGE, Sea, in *Natural History*, a name given by Count Marsigli to a very remarkable species of marine substance, which he denominates a *plant*. It is tough and firm in its structure, and in many things resembles the common fucus; but instead of growing in the branched form which the generality of those substances have, it is round and hollow, and in every respect resembles the shape of an orange. It has, by way of root, some exceeding fine filaments, which fasten themselves to the rocks, or to shells, stones, or any thing else that comes in the way. From these there grows no pedicle; but the body of the orange, as it is called, is fastened by them to the rock, or other solid substance. The orange itself is usually of about three or four inches in diameter; and while in the sea, is full of water, and even retains it when taken up. In this state it frequently weighs a pound and a half; but when the water is let out, and it is dried, it becomes a mere membrane, weighing scarce any thing. It is best preserved, by stuffing it with cotton as soon as the water is let out of it, and then hanging it up to dry. Its surface is irregular and rough, and its colour a dusky green on the outside, and a clearer but somewhat bluish green within; and its thickness is about an eighth part of an inch. When viewed by the microscope, it is seen to be all over covered with small glandules, or rather composed of them; for they stand so thick one by another as to leave no space between, and seem to make up the whole substance; so that it appears very like the rough shagreen skin used to cover toys. These are indeed so many hollow ducts, through which the sea-water finds a passage into the globe formed by this skin, and by this means it is kept always full and distended; on cutting it with a pair of scissars, the water immediately runs out, and the skins collapse; but there is something extremely remarkable in this, for the whole substance, near the wounded place, is in motion, and seems as if alive, and sensible of the wound. The glandules are found full of water, and resembling small transparent bottles; and what goes to the structure of the plant beside these, is an assemblage of a vast number of filaments, all which are likewise hollow, and filled with a clear and transparent fluid.

There is another substance of this kind, mentioned and described by Count Marsigli, Triumfetti, and others, and called the *ramose* or branched orange. This is very much of the nature of the former; but, instead of consisting of one round globule, it is formed of several oblong ones, all joined together, and representing the branches of some of the fucuses, only they are shorter; and these are all hollow and full of water, in the same manner as the single globes of the common kind. This has, by way of root, certain fine and slender filaments, which fasten it to the stones or shells near which it is produced; and it is of a dusky greenish colour on the surface, and of a fine bluish green within. The surface, viewed by the microscope, appears rough, as in the other, and the glandules are of the same kind, and are always found full of clear water.

ORATION, in *Rhetoric*, a speech or harangue, composed according to the rules of oratory, but spoken in public. Orations may be reduced to three kinds; viz. the demonstrative, deliberative, and judicial. To the demonstrative kind belong panegyrics, genethliaca, epithalamia, congratulations, &c. To the deliberate kind belong persuasion, exhortation, &c. And to the judicial kind belong accusation, confutation, &c.

Funeral

Orator.

Funeral ORATION. See FUNERAL *Oration*.

ORATOR, among the Romans, differed from a *patronus:* The latter was allowed only to plead causes on behalf of his clients; whereas the former might quit the forum and ascend the rostra or tribunal, to harangue the senate or the people. The orators had rarely a profound knowledge of the law, but they were eloquent, and their style was generally correct and concise. They were employed in causes of importance, instead of the common patrons. Orators in the violence of elocution used all the warmth of gesture, and even walked backwards and forwards with great heat and emotion. This it was which occasioned a witticism of Flavius Virginius, who asked one of those walking orators, *Quot millia passuum declamásset?* "How many MILES he had declaimed?" Similar to the Roman orators were the Grecian *Rhetores*. See RHETORES.

Public ORATOR, an office of very considerable dignity, and of some emolument, in the English universities.

The public orator is the principal, and in many cases the only ostensible, agent for the university in all those matters or forms which are merely external. He carries on or superintends all correspondences which are calculated to promote the dignity, or raise the utility, of the seminary which constitutes him. He has little to do, indeed, with the internal government of the body, for which a variety of officers in different departments are appointed; but in all public affairs he is, as it were, the mouth of the whole; putting their deliberations into proper form, and communicating or publishing them, according to the intention of the university. Thus, if the whole university, or a committee appointed by them, or by statute, or by the will of any particular benefactor, have, after a comparative trial, adjudged a prize to any person or persons, it is the business of the public orator to inform the successful parties of the issue of the trial. Again, If for singular learning, or for any remarkable *good will* shown to the university by any person or persons, the *senate* or *convocation* are pleased to declare their grateful sense of it either by conferring degrees, or otherwise, as they think fit, the public orator is to notify this intention to the person or persons concerned; and so in other cases.

Another part of the public orator's business is to present young noblemen, or those who take *honorary* degrees, *tanquam nobiles*, to the vice chancellor; this he does in a Latin speech, which, according to circumstances, is either short or long; and of which the subject is generally a defence of that particular statute which allows the sons of noblemen, and some few others, to proceed to degrees before what is called the *statutable time*. In doing this, encomiums, often stronger than just, are made upon the learning and virtue of the noble candidate; a view is taken of the dignity of his ancient house; the honour is mentioned which has accrued to the university from the accession of such a member; and the oration concludes with promising great credit from his future conduct, as well as benefit from the influence of his rank in the state. These circumstances are deemed sufficient grounds for exempting the sons of noblemen from that tedious course of study, through which the duller sons of commoners must all pass before they be thought worthy of academical honours.

Orator, Oratorio.

ORATORIO, in the Italian music, a sort of sacred drama of dialogues; containing recitativos, duettos, trios, ritornellos, choruses, &c. The subjects of those pieces are usually taken from Scripture, or the life of some saint, &c. The music for the oratorios should be in the finest taste and best chosen strains. These oratorios are greatly used at Rome in the time of Lent, and of late in England.

Menestrier attributes the origin of oratorios to the crusades, and says that the pilgrims returning from Jerusalem and the Holy Land, &c. composed songs reciting the life and death of the Son of God, and the mysteries of the Christian faith, and celebrating the achievements and constancy of saints and martyrs. Others, with more probability, observe, that the oratorio was an avowed imitation of the opera, with only this difference, that the foundation of it was always some religious or at least some moral subject. Crescimbeni ascribes its origin to San Filippo Neri, who was born at Florence in 1515, and who, in his chapel, after sermons, and other devotions, in order to allure young people to pious offices, had hymns, psalms, and such like prayers, sung by one or more voices. Among these spiritual songs were dialogues; and these entertainments becoming more frequent, and improving every year, were the occasion that in the seventeenth century oratorios were first invented, so called from the place of their origin. See *Hawkins's History of Music*.

ORATORY;

THE ART OF SPEAKING WELL UPON ANY SUBJECT, IN ORDER TO PERSUADE.

INTRODUCTION.

§ 1. *Of the Rise and Progress of Oratory.*

1 The origin of the art of oratory.

THE invention of oratory is, by the Egyptians, and the fables of the poets, ascribed to Mercury. And it is well known, that the Greeks made their deities the authors likewise of other arts, and supposed that they presided over them. Hence they gave Mercury the titles of Λογιος and Ἑρμης, both which names come from words that signify "to speak." And Aristides calls eloquence *the gift of Mercury;* and for the same reason anciently the tongue was consecrated to him. He was likewise said to be the interpreter or messenger of the gods; which office very well suited him, as he excelled in eloquence. Hence we read in the Sacred Writings, that when the people of Lystra took Barnabas and Paul for gods in human shape, because of that sudden and surprising cure which was wrought upon the lame man, they

they called Barnabas *Jupiter*, and Paul *Mercury;* for this reason, as the inspired writer tells us, 'because he was the chief speaker,' that is (as the spectators then thought), the interpreter or spokesman of Barnabas.

But to pass over these fictions of the heathen deities, let us hear what Quintilian says of the *origin* of this art; who seems to give a very probable account of it in the following passage. "The faculty of speech (says he) we derive from nature (A); but the art from observation. For as in physic, men, by seeing that some things promote health and others destroy it, formed the art upon those observations; in like manner, by perceiving that some things in discourse are said to advantage, and others not, they accordingly marked those things, in order to imitate the one and avoid the other. They also added some things from their own reason and judgement, which being confirmed by use, they began to teach others what they knew themselves." But no certain account can be given when, or by whom, this method of observation first began to take place. And Aristotle supposes, not without reason, that the first lineaments of the art were very rude and imperfect. Pausanias, indeed, in his *Description of Greece*, tells us, that Pittheus, the uncle of Theseus, taught it at Trœzene a city of Peloponnesus, and wrote a book concerning it; which he read himself, as it was published by one of Epidaurus. But as Pittheus lived about 1000 years before Pausanias, who flourished in the time of the emperor Hadrian, some are of opinion he might be imposed upon by the Epidaurian, who published this book under the name of *Pittheus*. But be that as it will, it is very reasonable to believe, that the Greeks had the principles of this art so early as the time of Pittheus. For Theseus his nephew lived not long before the taking of Troy, which, according to Sir Isaac Newton, happened 904 years before the birth of Christ; at which time Cicero thought it was in much esteem among them. "Homer (says he) would never have given Ulysses and Nestor in the Trojan war so great commendations on account of their speeches (to one of whom he attributes force, and to the other sweetness of expression), if eloquence had not in those times been in great repute." And lest any one should imagine, that in those days they made use only of such helps as nature and practice could afford them, the same poet informs us, that Peleus sent Phœnix with his son Achilles to the Trojan war, to instruct him not only in the art of war, but likewise of eloquence. But who were the professors of this art for some ages following is not known. For Quintilian says, that afterwards Empedocles is the first upon record who attempted any thing concerning it. And he, by Sir Isaac Newton's account, flourished about 500 years after Troy was taken. At which time, as Cicero observes, men being now sensible of the powerful charms of oratory, and the influence it had upon the mind, there immediately arose several masters of it; the chief of whom are mentioned by Quintilian, who tells us, that 'the oldest writers upon this art are Corax and Tisias, both of Sicily. After them came Gorgias of Leontium in the same island, who is said to have been the scholar of Empedocles, and by reason of his great age (for he lived to be 109 years old) had many cotemporaries. Thrasymachus of Chalcedon, Prodicus of Cea, Protagoras of Abdera, Hippias of Elis, and Alcidamus of Elea, lived in his time; as likewise Antiphon, who first wrote orations, and also upon the art, and is said to have spoken admirably well in his own defence; and besides these, Polycrates, and Theodore of Byzantium.' These persons contributed different ways towards the improvement of the art. Corax and Tisias gave rules for methodizing a discourse, and adjusting its particular parts; as may be conjectured from Cicero's account of them, who says, "Though some had spoke well before their time, yet none with order and method." But Gorgias seems to have excelled all the rest in fame and reputation: for he was so highly applauded by all Greece, that a golden statue was erected to him at Delphos, which was a distinguishing honour conferred upon him only. And he is said to have been so great a master of oratory, that in a public assembly he would undertake to declaim immediately upon any subject proposed to him. He wrote, as Cicero informs us, in the demonstrative or laudatory way; which requires most of the sublime, and makes what Diodorus Siculus says of him the more probable, that "he first introduced the strongest figures, members of periods opposite in sense, of an equal length, or ending with a like sound, and other ornaments of that nature." And hence those figures, which give the greatest force and lustre to a discourse, were anciently called by his name. Cicero tells us further, that Thrasymachus and Gorgias were the first who introduced numbers into prose, which Isocrates afterwards brought to perfection. Quintilian likewise mentions Protagoras, Gorgias, Prodicus, and Thrasymachus, as the first who treated of common places, and showed the use of them for the invention of arguments. Nor must we omit Plato, whose elegant dialogue upon this subject is still extant, which he entitles *Gorgias*. For though he does not lay down the common rules of the art; yet he very well explains the nature of it, and maintains its true end and use against the generality of its professors, who had greatly perverted the original design of it. Thus by the study and industry of so many ingenious and great men, the art of oratory was then carried to a considerable height among the Grecians: though many of those who professed it in those times employed their skill rather to promote their own reputation and applause, than to serve the real interests of truth and virtue. "For they proposed in an arrogant manner (as Cicero says) to teach how a bad cause might be so managed, as to get the better of a good one." That is, they would undertake to charm the ears and strike the passions of their hearers in so powerful a manner, by sophistical reasonings, turns of wit, and fine language, as to impose falsehood upon them for truth; than which nothing could be either more disingenuous in itself, or prejudicial to society.

2 Orators of Greece.

But those who succeeded them seem to have consulted

(A) If Quintilian meant that the human race speak an articulate language by nature or instinct, he certainly deceived himself (see LANGUAGE); but if his meaning was only that men have from nature a capability of speech, the observation is true, but not of much value. Parrots and other birds have a capability of uttering articulate sounds.

ed better, both for their own honour and that of their profeſſion. Iſocrates was the moſt renowned of all Gorgias's ſcholars, whom Cicero frequently extols with the higheſt commendations, as the greateſt maſter and teacher of oratory; "whoſe ſchool (as he ſays) like the Trojan horſe, ſent forth abundance of great men." Ariſtotle was chiefly induced to engage in this province from an emulation of his glory; and would often ſay in a verſe of Sophocles, ſomewhat varied to his purpoſe,

> To be ſilent it is a ſhame;
> While Iſocrates gets ſuch fame.

Quintilian ſays they both wrote upon the art, though there is no ſyſtem of the former now extant. But that of Ariſtotle is eſteemed the beſt and moſt complete of any in the Greek language. In this age the Grecian eloquence appeared in its higheſt perfection. Demoſthenes was a hearer both of Iſocrates and Plato, as alſo of Iſæus (ten of whoſe orations are yet extant); and by the aſſiſtance of a ſurpriſing genius, joined with indefatigable induſtry, made that advantage of their precepts, that he has been always eſteemed by the beſt judges the prince of Grecian orators. His great adverſary and rival Æſchines, after his baniſhment, is ſaid to have gone to Rhodes, and employed his time there in teaching of rhetoric. Theodectes and Theophraſtus, both of them ſcholars of Ariſtotle, imitated their maſter in writing upon the art. And from that time the philoſophers, eſpecially the Stoics and Peripatetics, applied themſelves to lay down the rules of oratory; which Socrates had before ſeparated from the province of a philoſopher. And there is yet preſerved a treatiſe upon this ſubject, which ſome have aſcribed to Demetrius Phalereus the Peripatetic, and ſcholar of Theophraſtus, though others more probably to Dionyſius of Halicarnaſſus. Quintilian mentions ſeveral other famous rhetoricians in the following ages, who were likewiſe writers: As Hermagoras, Athenæus, Apollonius Molon, Areus Cæcilius, Dionyſius of Halicarnaſſus, Apollonius of Pergamus, and Theodore of Gadara. But of theſe nothing now remains upon the ſubject of oratory, except ſome tracts of Dionyſius, who flouriſhed in the reign of Auguſtus Cæſar. Nor have there been wanting ſome eminent writers of this kind among the Greeks ſince the time of Quintilian; two of whom we cannot omit to mention, Hermogenes, and Longinus the author of the incomparable treatiſe Of the Sublime, a book which can ſcarcely be too much commended or too often read.

3 Riſe and progreſs of oratory in Rome.

It was long before Rome received this art, and not without difficulty at firſt. The reaſon was, becauſe the Romans were for ſeveral ages wholly addicted to military affairs, and to enlarge their territories; ſo that they not only neglected to cultivate learning, but thought the purſuit of it a thing of ill tendency, by diverting the minds of their youth from the cares and toils of war, to a more ſoft and indolent kind of life. Therefore ſo late as the year of their city 592, when by the induſtry of ſome Grecians the liberal arts began to flouriſh in Italy, a decree paſſed the ſenate, by which all philoſophers and rhetoricians were ordered to depart out of Rome. But in a few years after, when Carneades, Critolaus, and Diogenes, who were not only philoſophers but orators, came ambaſſadors from Athens to Rome, the Roman youth were ſo charmed with the eloquence of their harangues, that they could no longer be ſtopt from purſuing the ſtudy of oratory. And by a further acquaintance with the Greeks, it ſoon gained ſuch eſteem, that perſons of the firſt quality employed their time and pains to acquire it. And a young gentleman, who was ambitious to advance himſelf in the ſervice of his country, could have little hopes of ſucceſs, unleſs he had laid the foundation of his future proſpects in that ſtudy.

Seneca tells us, that Lucius Plotius, a Gaul, was the firſt who taught the art of oratory at Rome in Latin; which, Cicero ſays, was while he was a boy; and when the moſt ſtudious perſons went to hear him, he lamented that he could not go with them; being prevented by the regard he paid to the opinion of ſome of his friends, who thought that greater improvements were made by exerciſes in the Greek language under Grecian maſters. Seneca adds, that this profeſſion continued for ſome time in the hands of freedmen; and that the firſt Roman who engaged in it was Blandus of the equeſtrian order, who was ſucceeded by others; ſome of whoſe lives are yet extant, written by Suetonius, as many of the Grecians are by Philoſtratus and Eunapius. Quintilian likewiſe gives us the names of thoſe among the Romans, who wrote upon the art. "The firſt (ſays he) as far as I can learn, who compoſed any thing upon this argument, was M. Cato the cenſor. After him Antony the orator began upon the ſubject, which is the only work he has left, and that imperfect. Then followed ſome of leſs note. But he who carried eloquence to its higheſt pitch among us, was Cicero; who has likewiſe by his rules given the beſt plan both to practiſe and teach the art. After whom modeſty would require us to mention no more, had he not told us himſelf that his books of rhetoric ſlipt out of his hands, while he was but a youth. And thoſe leſſer things, which many perſons want, he has purpoſely omitted in his diſcourſes of oratory. Cornificius wrote largely upon the ſame ſubject; Stertinius and Gallio the father, each of them ſomething. But Celſus and Lenas were more accurate than Gallio; and in our times Virginius, Pliny, and Rutilius. And there are at this day ſome celebrated authors of the ſame kind, who, if they had taken in every thing, might have ſaved my pains." Time has ſince deprived us of moſt of the writers mentioned here by Quintilian. But we have the leſs reaſon to regret this loſs, ſince it has preſerved to us Cicero's treatiſes upon this ſubject; which we may well ſuppoſe to have been chiefly owing to their own excellency, and the great eſteem they have always had in the world. Beſides his Two books of Invention, which Quintilian here calls his Books of Rhetoric, there are extant of his, Three books of an Orator; one Of famous Orators; and another, which is called The Orator; as alſo his Topics, a preface Concerning the beſt ſort of Orators, and a treatiſe Of the parts of Oratory. Each of which treatiſes, whether we regard the juſtneſs and delicacy of the thoughts, the uſefulneſs of the rules, or the elegance and beauty of the ſtyle, deſerves to be frequently peruſed by all who are lovers of eloquence. For who can be thought ſo well qualified to give the rules of any art, as he who excelled all mankind in the practice of them? But thoſe Four Books to Herennius, which are publiſhed among Cicero's works, ſeem with good reaſon to be attributed to Cornificius, whom Quintilian here mentions. And Celſus is by ſome affirmed to have taught oratory, whom he alſo places among the rhetoricians, and whoſe Eight Books of Medicine are yet extant, written in ſo beautiful a ſtyle as plainly ſhows him to be a maſter of eloquence. But Quintilian himſelf outdid all who went before him in diligence and accuracy as a writer. His Inſtitutions are ſo comprehenſive, and written with ſuch great exactneſs and judgement, that they are generally allowed to be the moſt perfect work of the kind. With this excellent author we ſhall finiſh the account of the Latin rhetoricians.

There were indeed ſome others in the following ages, whoſe works are yet extant; but as they contain nothing of moment which is not to be found in thoſe already mentioned, we ſhall forbear to name them. Much leſs ſhall we deſcend to that numerous body of writers, who ſince the revival of learning have treated upon this ſubject, for the ſame reaſon. And a very good judge * has not long ſince given it as his opinion, that the method of forming the beſt ſyſtem of oratory, is to collect it from the fineſt precepts of Ariſtotle, Cicero, Quintilian, Longinus, and other celebrated authors; with proper examples taken from the choiceſt parts of the pureſt antiquity. And this is the method attempted to be purſued in the following treatiſe.

* Archbp. Cambray, *Lett.* p. 213.

§ 2. *Of the Nature of Oratory.*

The terms *rhetoric* and *oratory*, having no other difference but that one is taken from the Greek language and the other from the Latin, may be uſed promiſcuouſly; but the caſe is not the ſame with reſpect to the words *rhetorician* and *orator*. For although the Grecians uſed the former, both to expreſs thoſe who taught the art, and thoſe who practiſed it; yet the Romans afterward, when they took that word into their language, confined it to the teachers of the art, and called the reſt *orators*. And there ſeems to have been a ſufficient reaſon for this diſtinction, ſince the art was the ſame in both, and might therefore go by either name: but the different province of rhetoricians and orators made it not improper that they ſhould be called by different names. Beſides, anciently, before rhetoric was made a ſeparate and diſtinct art from philoſophy, the ſame perſons taught both. And then they were called not only *rhetoricians* but *ſophiſts*. But becauſe they often employed their art rather to vindicate what was falſe and unjuſt, than to ſupport truth and virtue; this diſingenuous conduct, by which they frequently impoſed upon weak minds, brought a diſcredit both upon themſelves and their profeſſion. And therefore the name *ſophiſt* or *ſophiſter*, has been more generally uſed in an ill ſenſe, to ſignify one ſkilled rather in the arts of cavilling, than qualified to ſpeak well and accurately upon any ſubject.

4 Oratory an art.

It is not neceſſary to uſe many words, to prove that oratory is an art. For it is compriſed under certain rules, agreeable to reaſon, delivered in a regular method, and ſuited to attain the end it propoſes; which are characters ſufficient to denominate it an art. Indeed the caſe is the ſame here as in moſt other things, that a good genius is of itſelf more ſerviceable than the moſt exact acquaintance with all the rules of art, where that is wanting. But it is ſufficient that art help nature, and carry it farther than it can otherwiſe advance without it. And he who is deſirous to gain the reputation of a good orator, will find the aſſiſtance of art very neceſſary. Some perſons have thought, that many of the common ſyſtems written upon the ſubject of oratory have been attended with this inconvenience, that, by burdening the mind with too great a number of rules about things of leſs importance, they have oftentimes rather diſcouraged than promoted the ſtudy of eloquence. This undoubtedly is an extreme which ſhould be always carefully avoided. But, however, an indifferent guide in a ſtrange road is better than none at all. It may be worth while to hear Quintilian's opinion upon this head. "I would not (ſays he) have young perſons think they are ſufficiently inſtructed, if they have learned one of thoſe compends which are commonly handed about, and fancy themſelves ſafe in the decrees, as it were, of theſe technical writers. The art of ſpeaking requires much labour, conſtant ſtudy, a variety of exerciſe, many trials, the greateſt prudence, and readineſs of thought. However, theſe treatiſes are uſeful, when they ſet you in a plain and open way, and do not confine you to one narrow track, from which he who thinks it a crime to depart muſt move as ſlowly as one that walks upon a rope." We ſee he is not for having us confine ourſelves too cloſely to ſyſtems, though he thinks they are of ſervice at firſt, till uſe and experience render them leſs neceſſary.

The buſineſs of oratory is to teach us to ſpeak well; which, as Cicero explains it, is to ſpeak *juſtly*, *methodically*, *floridly*, and *copiouſly*. 5 The object of it.

Now, in order to ſpeak *juſtly*, or pertinently, a perſon muſt be maſter of his ſubject, that he may be able to ſay all that is proper, and avoid whatever may appear foreign and trifling. And he muſt clothe his thoughts with ſuch words and expreſſions as are moſt ſuited to the nature of the argument, and will give it the greateſt force and evidence.

And as it teaches to ſpeak juſtly, ſo likewiſe *methodically*. This requires, that all the parts of a diſcourſe be placed in their proper order, and with ſuch juſt connexion, as to reflect a light upon each other, and thereby to render the whole both clear in itſelf, and eaſy to be retained. But the ſame method is not proper for all diſcourſes. And very frequently a different manner is convenient in handling the ſame ſubject. For it is plain, that art, as well as nature, loves variety; and it diſcovers the ſpeaker's judgement, when the diſpoſition of his diſcourſe is ſo framed, as to appear eaſy and natural, rather than the effect of induſtry and labour.

To ſpeak *floridly*, is ſo peculiar a property of this art, that ſome have wholly confined it to the pomp and ornaments of language. But that it extends farther, and reſpects things as well as words, we ſhall have occaſion to ſhow hereafter. It contains indeed the whole ſubject of elocution, but does not wholly conſiſt in it. True and ſolid eloquence requires not only the beauties and flowers of language, but likewiſe the beſt ſenſe and cleareſt reaſoning. Beſides, rhetoric gives rules for the ſeveral ſorts of ſtyle, and directs the uſe of them agreeably to the nature of the ſubject.

But the force of oratory appears in nothing more than a *copiouſneſs* of expreſſion, or a proper manner of enlargement, ſuited to the nature of the ſubject; which is of great uſe in perſuaſion, and forms the laſt property, required by Cicero, of ſpeaking well. A ſhort and concife account of things is often attended with obfcurity, from an omiffion of fome neceffary circumftances relating to them. Or, however, where that is not the cafe, yet for want of proper embellifhments to enliven the difcourfe, and thereby to excite and fix the hearers atten-

s'il se détermine enfin de donner tant à mon départ je vous le ferai savoir immédiatement — en attendant j'envoie la tabatière, répondant à mon billet d'aujourd'hui elle pourra ~~vous donner~~ d'ailleurs quelque doute, ~~que~~ [illegible] effleurera votre lettre — et elle sera retournée — dans de telles circonstances — Vous y verrez qu'on ne me presse pas de partir.

§ 3. *Of the Divifion of Oratory.*

Oratory confifts of four parts; *invention*, *difpofition*, ... and *pronunciation*. This will appear by con- ... he nature of each of them, and what it contri- ... orming an orator. Every one who aims to ... l and accurately upon any fubject, does natu- ... the firft place inquire after and purfue fuch ... as may feem moft proper to explain and illuf- ... thing upon which he defigns to difcourfe. ... ie nature of it requires that he fhould bring ... confirm what he fays, he not only feeks the ... and fuch as are like to be beft received; but ... ıres to anfwer any thing which may be offered ... ıtrary. This is *invention*.—After this he de- ... with himfelf in what method to difpofe of thofe ... ıich have occurred to his mind, that they may ... the plaineft light, and not lofe their force by ... nd confufion.—This is the bufinefs of *difpofi-* ... s next concern is to give his thoughts an a- ... lrefs; by making choice of the fitteft words, ... expreffions, fmooth and harmonious periods, ... r ornaments of ftyle, as may beft fuit the na- ... s fubject, brighten his difcourfe, and render it ... rtaining to his hearers. And this is called ... —The laft thing he attends to, is to deliver ... ıas thus compofed, with a juft and agreeable ... *tion*. And daily experience convinces us, how ... contributes both to engage the attention and ... hat is fpoken upon the mind. This then is the ... which nature directs, in order to qualify our- ... difcourfing to the beft advantage: Though ... and habit thefe things become fo familiar to ... ve do not always attend to them feparately in ... ral order. However, it is the bufinefs of art ... nature, and to treat of things in that manner ... dictates.

6 Oratory confifts of four parts.

... ION.

... to *demonftrative*, *deliberative*, or *judicial* dif- ... At prefent we fhall treat only upon the form- ... e. And now, that one thing may receive ... confirmation from another, it is neceffary that ... ome relation between them; for all things are ... y adapted to prove one another. Thus, in ... the quantity of two things which we would ... e either equal or unequal, if they are of fuch ... ıat one cannot be applied to the other, then ... third thing, which may be applied to them ... that muft be equal at leaft to one of the two, ... pplied to the other, and found equal to that ... refently conclude that thefe two things are ... t if it be unequal to the other, we fay that ... things are unequal. Becaufe it is the certain and known property of all quantities, that whatfoever two things are equal to a third, are equal to one another; and where one of any two things is equal to a third, and the other unequal, thofe two things are unequal to one another. What has been faid of quantities, will

And as different kinds of difcourfes require different arguments, rhetoricians have confidered them two ways; in general, under certain heads, as a common fund for all fubjects; and in a more particular manner, as they

to have taught oratory, whom he also places among the rhetoricians, and whose Eight Books of Medicine are yet extant, written in so beautiful a style as plainly shows him to be a master of eloquence. But Qui
himself outdid all who went before him in diligen
accuracy as a writer. His Institutions are so co
hensive, and written with such great exactne
judgement, that they are generally allowed to
most perfect work of the kind. With this excelle
thor we shall finish the account of the Latin r
cians.

There were indeed some others in the followin
whose works are yet extant; but as they contain n
of moment which is not to be found in those a
mentioned, we shall forbear to name them. Mu
shall we descend to that numerous body of writer
since the revival of learning have treated upon th
ject, for the same reason. And a very good judge *
not long since given it as his opinion, that the m
of forming the best system of oratory, is to col
from the finest precepts of Aristotle, Cicero, Quin
Longinus, and other celebrated authors; with
examples taken from the choicest parts of the pur
tiquity. And this is the method attempted to be
sued in the following treatise.

* Archbp. Cambray, *Lett.* p. 213.

§ 2. *Of the Nature of Oratory.*

The terms *rhetoric* and *oratory*, having no oth
ference but that one is taken from the Greek lan
and the other from the Latin, may be used pro
ously; but the case is not the same with respect t
words *rhetorician* and *orator*. For although the
cians used the former, both to express those who t
the art, and those who practised it; yet the Roma
terward, when they took that word into their lan
confined it to the teachers of the art, and called th
orators. And there seems to have been a sufficien
son for this distinction, since the art was the sa
both, and might therefore go by either name: bu
different province of rhetoricians and orators made
improper that they should be called by different n
Besides, anciently, before rhetoric was made a se
and distinct art from philosophy, the same persons t
both. And then they were called not only *rhetor*
but *sophists*. But because they often employed th
rather to vindicate what was false and unjust, th
support truth and virtue; this disingenuous condu
which they frequently imposed upon weak
brought a discredit both upon themselves and thei
fession. And therefore the name *sophist* or *sophiste*
been more generally used in an ill sense, to signi
skilled rather in the arts of cavilling, than qualifi
speak well and accurately upon any subject.

4 Oratory an art.

It is not necessary to use many words, to prov
oratory is an art. For it is comprised under c
rules, agreeable to reason, delivered in a regula
thod, and suited to attain the end it proposes;
are characters sufficient to denominate it an art.
deed the case is the same here as in most other things, that a good genius is of itself more serviceable than the most exact acquaintance with all the rules of art, where that is wanting. But it is sufficient that art help nature, and carry it farther than it can otherwise advance without it. And he who is desirous to gain the reputation of a good orator, will find the assistance of art very necessary. Some persons have thought, that many of the common systems written upon the subject

117 45 $\frac{654 \times 45 \times 468}{117 \times 9}$

468 9

$\frac{654 \times 45 \times 468}{117 \times 9 \times 1}$

ably to the nature of the subject.

But the force of oratory appears in nothing more than a *copiousness* of expression, or a proper manner of enlargement, suited to the nature of the subject; which is of great use in persuasion, and forms the last property, required by Cicero, of speaking well. A short and concise

ciſe account of things is often attended with obſcurity, from an omiſſion of ſome neceſſary circumſtances relating to them. Or, however, where that is not the caſe, yet for want of proper embelliſhments to enliven the diſcourſe, and thereby to excite and fix the hearers attention, it is apt to ſlip through their minds without leaving any impreſſion. But where the images of things are drawn in their full proportion, painted in their proper colours, ſet in a clear light, and repreſented in different views, with all the ſtrength and beauties of eloquence, they captivate the minds of the audience with the higheſt pleaſure, engage their attention, and by an irreſiſtible force move and bend them to the deſign of the ſpeaker.

The principal end and deſign of oratory is to perſuade: for which reaſon it is frequently called the *art of perſuaſion*. Indeed the orator has often other ſubordinate views; as when he endeavours either to delight his hearers with what is pleaſant and agreeable, or to conciliate their good opinion by a ſmooth and artful addreſs: but ſtill both theſe are in order to perſuade and excite them to action.

An objection may, perhaps, hence be formed againſt eloquence, as an art which may be employed for perſuading to ill as well as to good. There is no doubt that it may; and ſo reaſoning may alſo be, and too often is, employed for leading men into error. But who would think of forming an argument from this againſt the cultivation of our reaſoning powers? Reaſon, eloquence, and every art which ever has been ſtudied among mankind, may be abuſed, and may prove dangerous in the hands of bad men: but it were perfectly childiſh to contend, that upon this account they ought to be aboliſhed.

While the orator employs his art in purſuing only thoſe ends for which it was at firſt deſigned, the perſuading men to good and virtuous actions, and diſſuading them from every thing that is ill and vicious; nothing can be more commendable in itſelf, or uſeful to human ſocieties.

§ 3. *Of the Diviſion of Oratory.*

Oratory conſiſts of four parts; *invention*, *diſpoſition*, *elocution*, and *pronunciation*. This will appear by conſidering the nature of each of them, and what it contributes in forming an orator. Every one who aims to ſpeak well and accurately upon any ſubject, does naturally in the firſt place inquire after and purſue ſuch thoughts as may ſeem moſt proper to explain and illuſtrate the thing upon which he deſigns to diſcourſe. And if the nature of it requires that he ſhould bring reaſons to confirm what he ſays, he not only ſeeks the ſtrongeſt, and ſuch as are like to be beſt received; but alſo prepares to anſwer any thing which may be offered to the contrary. This is *invention*.—After this he deliberates with himſelf in what method to diſpoſe of thoſe things which have occurred to his mind, that they may appear in the plaineſt light, and not loſe their force by diſorder and confuſion.—This is the buſineſs of *diſpoſition*.—His next concern is to give his thoughts an agreeable dreſs; by making choice of the fitteſt words, cleareſt expreſſions, ſmooth and harmonious periods, with other ornaments of ſtyle, as may beſt ſuit the nature of his ſubject, brighten his diſcourſe, and render it moſt entertaining to his hearers. And this is called *elocution*.—The laſt thing he attends to, is to deliver what he has thus compoſed, with a juſt and agreeable *pronunciation*. And daily experience convinces us, how much this contributes both to engage the attention and impreſs what is ſpoken upon the mind. This then is the method to which nature directs, in order to qualify ourſelves for diſcourſing to the beſt advantage: Though by cuſtom and habit theſe things become ſo familiar to us, that we do not always attend to them ſeparately in their natural order. However, it is the buſineſs of art to follow nature, and to treat of things in that manner which ſhe dictates. 6 Oratory conſiſts of four parts.

PART I. OF INVENTION.

CHAP. I. *Of Invention in general; and particularly of Common Places, and State of a Cauſe.*

7 Invention the diſcovery of ſuch things as are fitted to perſuade.

INVENTION, conſidered in general, is the diſcovery of ſuch things as are proper to perſuade. And in order to attain this end, the orator propoſes to himſelf three things: To prove or illuſtrate the ſubject upon which he treats; to conciliate the minds of his hearers; and to engage their paſſions in his favour. And as theſe require different kinds of arguments or motives, invention furniſhes him with a ſupply for each of them, as will be ſhown in their order.

An argument, as defined by Cicero, is a reaſon which induces us to believe what before we doubted of.

And as different kinds of diſcourſes require different arguments, rhetoricians have conſidered them two ways; in general, under certain heads, as a common fund for all ſubjects; and in a more particular manner, as they are ſuited to *demonſtrative*, *deliberative*, or *judicial* diſcourſes. At preſent we ſhall treat only upon the former of theſe. And now, that one thing may receive proof and confirmation from another, it is neceſſary that there be ſome relation between them; for all things are not equally adapted to prove one another. Thus, in meaſuring the quantity of two things which we would ſhow to be either equal or unequal, if they are of ſuch a nature that one cannot be applied to the other, then we take a third thing, which may be applied to them both; and that muſt be equal at leaſt to one of the two, which if applied to the other, and found equal to that alſo, we preſently conclude that theſe two things are equal; but if it be unequal to the other, we ſay that theſe two things are unequal. Becauſe it is the certain and known property of all quantities, that whatſoever two things are equal to a third, are equal to one another; and where one of any two things is equal to a third, and the other unequal, thoſe two things are unequal to one another. What has been ſaid of quantities, will

Invention. will hold true in all other cases, that so far as any two things or ideas agree to a third, so far they agree to one another. So likewise, on the contrary, as far as one of any two things or ideas does agree to a third, and the other does not, so far they disagree with one another; in which respect, one of them cannot be truly affirmed of the other. Since, therefore, in every proposition, one thing is spoken of another, if we would find out whether the two ideas agree to each other or not, where this is not evident of itself, we must find out some third thing, the idea of which agrees to one of them; and then that being applied to the other, as it does agree or disagree with it, so we may conclude, that the two things proposed do agree or disagree with one another. This will be made more clear by an example or two. Should it be inquired, *Whether virtue is to be loved;* the argument between virtue and love might be found by comparing them separately with happiness, as a common measure to both. For since the idea of happiness agrees to that of love, and the idea of virtue to that of happiness; it follows, that the ideas of virtue and love agree to one another: and therefore it may be affirmed, *That virtue is to be loved.* But, on the contrary, because the idea of misery disagrees with that of love, but the idea of vice agrees to that of misery, the two ideas of vice and love must consequently disagree with one another; and therefore it would be false to assert, *That vice is to be loved.* Now, this third thing logicians call the *medium*, or *middle term*, because it does as it were connect two extremes; that is, both parts of a proposition. But rhetoricians call it an *argument*, because it is so applied to what was before proposed, as to become the instrument of procuring our assent to it. Thus far as to the nature and use of arguments. We shall next explain by what methods they are to be sought.

8 These called arguments.

A lively imagination, and readiness of thought, are undoubtedly a very great help to invention. Some persons are naturally endued with that quickness of fancy, and penetration of mind that they are seldom at a loss for arguments either to defend their own opinions, or to attack their adversaries. However, these things being the gift of nature, and not to be gained by art, do not properly fall under our present consideration.

9 Learning necessary to an orator.

It will be readily granted, that great learning and extensive knowledge are a noble fund for invention. An orator therefore should be furnished with a stock of important truths, solid maxims of reason, and a variety of knowledge, collected and treasured up both from observation and a large acquaintance with the liberal arts, that he may not only be qualified to express himself in the most agreeable manner, but likewise to support what he says with the strongest and clearest arguments.

But because all are not born with a like happy genius, and had not the same opportunity to cultivate their minds with learning and knowledge; and because nothing is more difficult than to dwell long upon the consideration of one thing, in order to find out the strongest arguments which may be offered for and against it; upon these accounts, art has prescribed a method to lessen, in some measure, these difficulties, and help every one to a supply of arguments upon any subject. And this is done by the contrivance of *common places*, which Cicero calls the *seats* or *heads of arguments*, and by a Greek name *topics*. They are of two sorts, *internal* and *external*.

10 Rules of art to supply the place of extensive learning or acute genius.

I. *Internal topics.* Though things, with regard to their nature and properties, are exceedingly various, yet they have certain common relations, by means whereof the truth of what is either affirmed or denied concerning them in any respect may be evinced. The ancient Greek rhetoricians therefore reduced these relations to some general heads, which are termed *loci* or *common places;* because the reasons or arguments suited to prove any proposition are reposited in them, as a common fund or receptacle. And they are called *internal heads*, because they arise from the subject upon which the orator treats; and are therefore distinguished from others named *external*, which he fetches from without, and applies to his present purpose, as will be shown herafter. Cicero and Quintilian make them 16; three of which comprehend the whole thing they are brought to prove, namely, *definition, enumeration*, and *notation:* of the remaining 13, some contain a part of it, and the rest its various properties and circumstances, with other considerations relating to it; and these are, *genus, species, antecedents, consequents, adjuncts, conjugates, cause, effect, contraries, opposites, similitude, dissimilitude*, and *comparison*.

Definition explains the nature of the thing defined, and shows what it is. And to whatsoever the definition agrees, the thing defined does so likewise. If therefore Socrates be a rational creature, he is a man; because it is the definition of a man, that he is a rational creature.

Enumeration takes in all the parts of a thing. And from this we prove, that what agrees to all the parts agrees to the whole; and what does not agree to any one or more parts, does not agree to the whole: As when Cicero proves to Piso that all the Roman state hated him, by enumerating the several ranks and orders of Roman citizens who all did so.

Notation, or etymology, explains the meaning or signification of a word. From which we reason thus: "If he cannot pay his debts, he is insolvent;" for that is the meaning of the word *insolvent*.

Genus is what contains under it two or more sorts of things, differing in nature. From this head logicians reason thus: "Because every animal is mortal, and man is an animal, therefore man is mortal." But orators make a further use of this argument, which they call *ascending from the hypothesis to the thesis;* that is, from a particular to a general: As should a person, when speaking in praise of justice, take occasion from thence to commend and show the excellency of virtue in general, with a view to render that particular virtue more amiable. For since every species contains in it the whole nature of the genus to which it relates, besides what is peculiar to itself, whereby it is distinguished from it; what is affirmed of the genus, must of necessity be applicable to the species.

Species is that which comprehends under it all the individuals of the same nature. From hence we may argue, "He is a man, therefore he has a rational soul." And orators sometimes take occasion from this head to descend from the thesis to the hypothesis; that

Invention. that is, in treating upon what is more general, to introduce some particular contained under it, for the greater illustration of the general.

Antecedents are such things, as, being once allowed, others necessarily, or very probably, follow. From this head an inseparable property is proved from its subject: as, It is material, and therefore corruptible.

Consequents are such things as, being allowed, necessarily or very probably infer their antecedents. Hence the subject is proved from an inseparable property, in this manner: It is corruptible, and therefore material.

Adjuncts are separable properties of things, or circumstances that attend them. These are very numerous, and afford a great variety of arguments, some of which usually occur in every discourse. They do not necessarily infer their subject; but, if fitly chosen, render a thing credible, and are a sufficient ground for assent. The way of reasoning from them we shall show presently.

Conjugates are words deduced from the same origin with that of our subject. By these the habit is proved from its acts: as, He who does justly is just. He does not act wisely, therefore he is not wise. But this inference will not hold, unless the actions appear continued and constant.

A *cause* is that, by the force of which a thing does exist. There are four kinds of causes, matter, form, efficient, and end, which afford a great variety of arguments. The way of reasoning from them is to infer the effect from the cause: as, Man is endued with reason, therefore he is capable of knowledge.

An *effect* is that which arises from a cause, therefore the cause is proved by it: as, He is endued with knowledge, therefore with reason.

Contraries are things, which, under the same genus, are at the utmost distance from each other; so that what we grant to the one, we utterly deny the other: as Virtue ought to be embraced, therefore vice should be avoided.

Opposites are such things, which, though repugnant to each other, yet are not directly contradictory; as, To love and to injure, to hate and to commend. They differ from contraries in this, that they do not absolutely exclude one another. An argument is drawn from things repugnant, thus: He will do a man a mischief, therefore he does not love him. He loves a man, therefore he will not reproach him.

Similitude is an agreement of things in quality. Thus Cicero proves, that pernicious citizens ought to be taken out of the state, by the likeness they bear to corrupted members, which are cut off to prevent further damage to the body.

Dissimilitude is a disagreement of things in quality. From this head Cicero shows the preference of his own exile to Piso's government of Macedonia; by the difference between their conduct, and the people's esteem of them.

Comparison is made three ways: for either a thing is compared with a greater, with a less, or with its equal. This place, therefore, differs from that of similitude on this account, that the quality was considered in that, but here the quantity. An argument from the greater is thus drawn: If five legions could not conquer the enemy, much less will two.

We shall just give one example of the manner of reasoning from these heads, whereby the use of them may farther appear. If any one, therefore, should have endeavoured to persuade Cicero not to accept of his life upon the condition offered him by Antony, That he would burn his Philippic orations which had been spoken against him, he might be supposed to use such arguments as these; partly taken from the adjuncts of Cicero, partly from those of Antony, and partly from the thing itself. And first with regard to Cicero, it might be said, That so great a man ought not to purchase his life at so dear a price as the loss of that immortal honour which by so great pains and labour he had acquired. And this might be confirmed by another argument, That now he was grown old, and could not expect to live much longer. And from the character of Antony he might argue thus; That he was very crafty and deceitful; and only designed, by giving him hopes of life, to have the Philippics first burnt, which otherwise he knew would transmit to posterity an eternal brand of infamy upon him; and then he would take off the author. And this might be shown by comparison. For since he would not spare others, who had not so highly exasperated him, and from whom he had not so much to fear; certainly he would not forgive Cicero, since he knew well enough, that so long as he lived, he himself could never be in safety. And, lastly, An argument might also be fetched from the nature of the thing itself in the following manner: That Cicero, by this action would shamefully betray the state, and the cause of liberty, which he had through his whole life most courageously defended, with so great honour to himself, and advantage to the public. Upon such an account, a person might have used these or the like arguments with Cicero, which arise from the fore-mentioned heads.

Invention. 11 The manner of reasoning from these heads.

12 They are of no solid utility unless there is a previous foundation of learning and genius.

From this account of common places, it is easy to conceive what a large field of discourse they open to the mind upon every subject. At the same time, though we have mentioned them from our respect for the orators of Greece and Rome, we heartily subscribe to the opinion of a celebrated modern, who gives of them the following account.

"The Grecian sophists were the first inventors of this artificial system of oratory; and they showed a prodigious subtility and fertility in the contrivance of these loci. Succeeding rhetoricians, dazzled by the plan, wrought them into so regular a system, that one would think they meant to teach how a person might mechanically become an orator, without any genius at all. They gave him receipts for making speeches on all manner of subjects. At the same time, it is evident, that though this study of common places might produce very showy academical declamations, it could never produce useful discourses on real business. The loci indeed supplied a most exuberant fecundity of matter. One who had no other aim, but to talk copiously and plausibly, by consulting them on every subject, and laying hold of all that they suggested, might discourse without end; and that, too, though he had none but the most superficial knowledge of his subject. But such discourse could be no other than trivial. What is truly solid and persuasive, must be drawn *ex visceribus causæ*, from a thorough knowledge of the subject, and profound meditation on it. They who would direct students of oratory *Blair's Lectures.*

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tory to any other ſources of argumentation, only delude them; and by attempting to render rhetoric too perfect an art, they render it, in truth, a trifling and childiſh ſtudy."

13 Of external topics, generally called *teſtimonies*.

II. *Of external topics.* When the orator reaſons from ſuch topics as do not ariſe from his ſubject, but from things of a different nature, theſe are called *external.* They are all taken from authorities, and are by one general name called *teſtimonies.*

Now a teſtimony may be expreſſed by writing, ſpeech, or any other ſign proper to declare a perſon's mind. And all teſtimonies may be diſtinguiſhed into two ſorts, divine and human. A divine teſtimony, when certainly known to be ſuch, is inconteſtable, and admits of no debate, but ſhould be acquieſced in without heſitation. Indeed the ancient Greeks and Romans eſteemed the pretended oracles of their deities, the anſwers of their augurs, and the like fallacies, divine teſtimonies: but with us no one can be ignorant of their true notion, though they do not ſo directly come under our preſent conſideration. Human teſtimonies, conſidered as furniſhing the orator with arguments, may be reduced to three heads; *writings*, *witneſſes*, and *contracts.*

14 Reduced to three heads, and ſeparately explained.

1. By *Writings*, here, are to be underſtood written laws, wills, or other legal inſtruments, expreſſed and conveyed in that manner. And it is not ſo much the force and validity of ſuch teſtimonies, conſidered in themſelves, that is here intended, as the occaſion of diſpute which may at any time ariſe concerning their true deſign and import, when produced in proof upon either ſide of a controverſy. And theſe are five; Ambiguity, Diſagreement between the words and intention, Contrariety, Reaſoning, and Interpretation.

A writing is then ſaid to be ambiguous, when it is capable of two or more ſenſes, which makes the writer's deſign uncertain. Now ambiguity may ariſe either from ſingle words, or the conſtruction of ſentences. From ſingle words; as when either the ſenſe of a word, or the application of it, is doubtful. As, ſhould it be queſtioned, whether ready money ought to be included under the appellation of chattels left by a will; or, if a teſtator bequeath a certain legacy to his nephew Thomas, and he has two nephews of that name. But ambiguity is alſo ſometimes occaſioned from the conſtruction of a ſentence; as when ſeveral things or perſons having been already mentioned, it is doubtful to which of them that which follows ought to be referred. For example, a perſon writes thus in his will: 'Let my heir give as a legacy to Titius a horſe out of my ſtable, which he pleaſes.' Here it may be queſtioned, whether the word *he* refers to the heir or to Titius; and conſequently, whether the heir be allowed to give Titius which horſe he pleaſes, or Titius may chooſe which he likes beſt. Now as to controverſies of this kind, in the firſt caſe above mentioned, the party who claims the chattels may plead, that all moveable goods come under that name, and therefore that he has a right to the money. This he will endeavour to prove from ſome inſtances where the word has been ſo uſed. The buſineſs of the oppoſite party is to refute this, by ſhowing that money is not there included. And if either ſide produce precedents in his favour, the other may endeavour to ſhow that the caſes are not parallel. As to the ſecond caſe, ariſing from an ambiguity in the name, if any other words or expreſſions in the will ſeem to countenance either of the claimants, he will not fail to interpret them to his advantage. So likewiſe, if any thing ſaid by the teſtator, in his lifetime, or any regard ſhown to either of theſe nephews more than the other, may help to determine which of them was intended, a proper uſe may be made of it. And the ſame may be ſaid with regard to the third caſe. In which the legatee may reaſon likewiſe from the common uſe of language, and ſhow that in ſuch expreſſions it is uſual to make the reference to the laſt or next antecedent; and from thence plead, that it was the deſign of the teſtator to give him the option. But in anſwer to this, it may be ſaid, that allowing it to be very often ſo, yet in this inſtance it ſeems more eaſy and natural to repeat the verb *give* after *pleaſes*, and ſo to ſupply the ſentence, *which he pleaſes to give him*, referring it to the heir, than to bring in the verb *chooſe*, which was not in the ſentence before; and ſo, by ſupplying the ſenſe, *which he pleaſes to chooſe*, to give the option to Titius. But where controverſies of this kind ariſe from a law, recourſe may be had to other laws where the ſame thing has been expreſſed with greater clearneſs; which may help to determine the ſenſe of the paſſage in diſpute.

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A ſecond controverſy from writings is, when one party adheres to the words, and the other to what he aſſerts was the writer's intention. Now he who oppoſes the literal ſenſe, either contends, that what he himſelf offers is the ſimple and plain meaning of the writing, or that it muſt be ſo underſtood in the particular caſe in diſpute. An inſtance of the former is this, as we find it in Cicero. A perſon who died without children, but left a widow, had made this proviſion in his will: "If I have a ſon born to me, he ſhall be my heir." And a little after: "If my ſon die before he comes of age, let Curius be my heir." There is no ſon born: Curius therefore ſues for the eſtate, and pleads the intention of the teſtator, who deſigned him for his heir, if he ſhould have no ſon who arrived at age; and ſays, there can be no reaſon to ſuppoſe he did not intend the ſame perſon for his heir if he had no ſon, as if he ſhould have one who afterwards died in his minority. But the heir at law inſiſts upon the words of the will; which, as he ſays, require, that firſt a ſon ſhould be born, and afterwards die under age, before Curius can ſucceed to the inheritance; and there being no ſon, a ſubſtituted heir, as Curius was, can have no claim where the firſt heir does not exiſt, from whom he derives his pretenſion, and was to ſucceed by the appointment of the will.—Of the latter caſe, rhetoricians give this example: "It was forbidden by a law to open the city gates in the night. A certain perſon notwithſtanding, in time of war, did open them in the night, and let in ſome auxiliary troops, to prevent their being cut off by the enemy, who was poſted near the town." Afterwards, when the war was over, this perſon is arraigned, and tried for his life, on account of this action. Now, in ſuch a caſe, the proſecutor founds his charge upon the expreſs words of the law; and pleads, that no ſufficient reaſon can be aſſigned for going contrary to the letter of it, which would be to make a new law, and not to execute one already made. The defendant, on the other hand, alleges, That the fact he is charged

with

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with cannot, however, come within the intention of the law; ſince he either could not, or ought not, to have complied with the letter of it in that particular caſe, which muſt therefore neceſſarily be ſuppoſed to have been excepted in the deſign of that law when it was made. But to this the proſecutor may reply, That all ſuch exceptions as are intended by any law, are uſually expreſſed in it: and inſtances may be brought of particular exceptions expreſſed in ſome laws; and if there be any ſuch exception in the law under debate, it ſhould eſpecially be mentioned. He may further add, That to admit of exceptions not expreſſed in the law itſelf, is to enervate the force of all laws, by explaining them away, and in effect to render them uſeleſs. And this he may further corroborate, by comparing the law under debate with others, and conſidering its nature and importance, and how far the public intereſt of the ſtate is concerned in the due and regular execution of it; from whence he may infer, that ſhould exceptions be admitted in other laws of leſs conſequence, yet, however, they ought not in this. Laſtly, He may conſider the reaſon alleged by the defendant, on which he founds his plea, and ſhow there was not that neceſſity of violating the law in the preſent caſe, as is pretended. And this is often the more requiſite, becauſe the party who diſputes againſt the words of the law, always endeavours to ſupport his allegations from the equity of the caſe. If, therefore, this plea can be enervated, the main ſupport of the defendant's cauſe is removed. For as the former arguments are deſigned to prevail with the judge, to determine the matter on this ſide the queſtion from the nature of the caſe; ſo the intention of this argument is to induce him to it, from the weakneſs of the defence made by the oppoſite party. But the defendant will, on the contrary, uſe ſuch arguments as may beſt demonſtrate the equity of his cauſe, and endeavour to vindicate the fact from his good deſign and intention in doing it. He will ſay, That the laws have allotted puniſhments for the commiſſion of ſuch facts as are evil in themſelves, or prejudicial to others; neither of which can be charged upon the action for which he is accuſed: That no law can be rightly executed, if more regard be had to the words and ſyllables of the writing, than to the intention of the legiſlator. To which purpoſe, he may allege that direction of the law itſelf, which ſays, "The law ought not to be too rigorouſly interpreted, nor the words of it ſtrained; but the true intention and deſign of each part of it duly conſidered." As alſo that ſaying of Cicero, "What law may not be weakened and deſtroyed, if we bend the ſenſe to the words, and do not regard the deſign and view of the legiſlator?" Hence he may take occaſion to complain of the hardſhip of ſuch a procedure, that no difference ſhould be made between an audacious and wilful crime, and an honeſt or neceſſary action, which might happen to diſagree with the letter of the law, though not with the intent of it. And as it was obſerved before to be of conſiderable ſervice to the accuſer, if he could remove the defendant's plea of equity, ſo it will be of equal advantage to the defendant, if he can fix upon any words in the law, which may in the leaſt ſeem to countenance his caſe, ſince this will take off the main force of the charge.

The third controverſy of this kind is, when two writings happen to claſh with each other, or at leaſt ſeem to do ſo. Of this Hermogenes gives the following inſtance. One law enjoins: "He who continues alone in a ſhip during a tempeſt, ſhall have the property of the ſhip." Another law ſays, "A diſinherited ſon ſhall enjoy no part of his father's eſtate." Now a ſon, who had been diſinherited by his father, happens to be in his father's ſhip in a tempeſt, and continues there alone, when every one elſe had deſerted it. He claims the ſhip by the former of theſe laws, and his brother tries his right with him by the latter. In ſuch caſes, therefore, it may firſt be conſidered, "Whether the two laws can be reconciled. And if that cannot be done, then, Which of them appears more equitable. Alſo, Whether one be poſitive, and the other negative: becauſe prohibitions are a ſort of exceptions to poſitive injunctions. Or, If one be a general law, and the other more particular, and come nearer to the matter in queſtion. Likewiſe, Which was laſt made: ſince former laws are often abrogated, either wholly or in part, by ſubſequent laws; or at leaſt were deſigned to be ſo. Laſtly, It may be obſerved, Whether one of the laws be not plain and expreſs; and the other more dubious, or has any ambiguity in it. All, or any of which things, that party will not omit to improve for his advantage whoſe intereſt is concerned in it.

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The fourth controverſy is *reaſoning*. As when ſomething, not expreſsly provided for by a law, is inferred by a ſimilitude, or parity of reaſon, from what is contained in it. Quintilian mentions this inſtance of it. "There was a law made at Tarentum, to prohibit the exportation of wool; but a certain perſon exports ſheep." In this caſe, the proſecutor may firſt compare the thing which occaſions the charge, with the words of the law, and ſhow their agreement, and how unneceſſary it was that particular thing ſhould have been expreſsly mentioned in the law, ſince it is plainly contained in it, or at leaſt an evident conſequence from it. He may then plead, that many things of a like nature are omitted in other laws for the ſame reaſon. And, laſtly, He may urge the reaſonableneſs and equity of the procedure. The defendant, on the other hand, will endeavour to ſhow the deficiency of the reaſoning, and the difference between the two caſes. He will inſiſt upon the plain and expreſs words of the law, and ſet forth the ill tendency of ſuch inferences and concluſions drawn from ſimilitudes and compariſons, ſince there is ſcarce any thing but in ſome reſpect may bear a reſemblance to another.

The laſt controverſy under this head is *interpretation*, in which the diſpute turns upon the true meaning and explication of the law in reference to that particular caſe. We have the following inſtance of this in the Pandects: "A man who had two ſons both under age, ſubſtitutes Titius as heir to him who ſhould die laſt, provided both of them died in their minority. They both periſh together at ſea before they came to age. Here ariſes a doubt, whether the ſubſtitution can take place, or whether the inheritance devolves to the heir at law." The latter pleads, That as neither of them can be ſaid to have died laſt, the ſubſtitution cannot take place; which was ſuſpended, upon the condition that one died after the other.

But

But to this it may be ſaid, It was the intention of the teſtator, that if both died in their nonage, Titius ſhould ſucceed to the inheritance; and therefore it makes no difference whether they died together, or one after the other: and ſo the law determines it.

2. The *ſecond* head of external arguments are *Witneſſes*. Theſe may either give their evidence, when abſent, in writing ſubſcribed with their name; or preſent, by word of mouth. And what both of them teſtify, may either be from hearſay; or what they ſaw themſelves, and were preſent at the time it was done. As the weight of the evidence may be thought greater or leſs on each of theſe accounts, either party will make ſuch uſe of it as he finds for his advantage. The characters of the witneſſes are alſo to be conſidered; and if any thing be found in their lives or behaviour that is juſtly exceptionable, to invalidate their evidence, it ought not to be omitted. And how they are affected to the contending parties, or either of them, may deſerve conſideration; for ſome allowances may be judged reaſonable in caſe of friendſhip, or enmity, where there is no room for any other exception. But regard ſhould chiefly be had to what they teſtify, and how far the cauſe is affected by it. Cicero is very large upon moſt of theſe heads in his defence of Marcus Fonteius, with a deſign to weaken the evidence of the Gauls againſt him. And where witneſſes are produced on one ſide only, as orators ſometimes attempt to leſſen the credit of this kind of proof, by pleading that witneſſes are liable to be corrupted, or biaſſed by ſome prevailing intereſt or paſſion, to which arguments taken from the nature and circumſtances of things are not ſubject; it may be anſwered on the other hand, that ſophiſtical arguments and falſe colourings are not expoſed to infamy or puniſhment, whereas witneſſes are reſtrained by ſhame and penalties, nor would the law require them if they were not neceſſary.

3. The *third* and laſt head of external arguments are *Contracts;* which may be either public or private. By public are meant the tranſactions between different ſtates, as leagues, alliances, and the like; which depend on the laws of nations, and come more properly under deliberative diſcourſes, to which we ſhall refer them. Thoſe are called *private*, which relate to leſſer bodies or ſocieties of men, and ſingle perſons; and may be either written or verbal. And it is not ſo much the true meaning and purport of them that is here conſidered as their force and obligation. And, as the Roman law declares, "Nothing can be more agreeable to human faith, than that perſons ſhould ſtand to their agreements." Therefore in controverſies of this kind, the party whoſe intereſt it is that the contract ſhould be maintained, will plead, that ſuch covenants have the force of private laws, and ought religiouſly to be obſerved, ſince the common affairs of mankind are tranſacted in that manner; and therefore to violate them, is to deſtroy all commerce and ſociety among men. On the other ſide it may be ſaid, that juſtice and equity are chiefly to be regarded, which are immutable; and beſides, that the public laws are the common rule to determine all differences, which are deſigned to redreſs thoſe who are aggrieved. And indeed, where a compact has been obtained by force or fraud, it is in itſelf void, and has no effect either in law or reaſon. But on the other hand, the Roman lawyers ſeem to have very rightly determined, that all ſuch obligations as are founded on natural equity, though not binding by national laws, and are therefore called *nuda pacta*, ought, however, in honour and conſcience, to be performed.

15
Of the ſtate of a controverſy, or the manner of referring the principal queſtion in diſpute to ſome particular head for greater eaſe of argument.

III. *Of the State of a Controverſy.* The ancients, obſerving that the principal queſtion or point of diſpute in all controverſies might be referred to ſome particular head, reduced theſe heads to a certain number, that both the nature of the queſtion might by that means be better known, and the arguments ſuited to it be diſcovered with greater eaſe. And theſe heads they call *ſtates*.

By the ſtate of a controverſy, then, we are to underſtand the principal point in diſpute between contending parties, upon the proof of which the whole cauſe or controverſy depends. We find it expreſſed by ſeveral other names in ancient writers: as, the *conſtitution of the cauſe*, the *general head*, and the *chief queſtion*. And as this is the principal thing to be attended to in every ſuch diſcourſe; ſo it is what firſt requires the conſideration of the ſpeaker, and ſhould be well fixed and digeſted in his mind, before he proceeds to look for arguments proper to ſupport it. Thus Antony, the Roman orator, ſpeaking of his own method in his pleading, ſays: "When I underſtand the nature of the cauſe, and begin to conſider it, the firſt thing I endeavour to do is, to ſettle with myſelf what that is to which all my diſcourſe relating to the matter in diſpute ought to be referred: then I diligently attend to theſe other two things, How to recommend myſelf, or thoſe for whom I plead, to the good eſteem of my hearers; and how to influence their minds, as may beſt ſuit my deſign." This way of proceeding appears very agreeable to reaſon and prudence. For what can be more abſurd, than for a perſon to attempt the proof of any thing, before he has well ſettled in his own mind a clear and diſtinct notion what the thing is which he would endeavour to prove? Quintilian deſcribes it to be, 'That kind of queſtion which ariſes from the firſt conflict of cauſes.' In judicial caſes, it immediately follows upon the charge of the plaintiff, and plea of the defendant. Our common law expreſſes it by one word, namely the *iſſue*. Which interpreters explain, by deſcribing it to be, "That point of matter depending in ſuit, whereupon the parties join, and put their cauſe to the trial." Examples will further help to illuſtrate this, and render it more evident. In the cauſe of Milo, the charge of the Clodian party is, *Milo killed Clodius*. Milo's plea or defence, *I killed him, but juſtly*. From hence ariſes this grand queſtion, or ſtate of the cauſe, *Whether it was lawful for Milo to kill Clodius?* And that Clodius was lawfully killed by Milo, is what Cicero in his defence of Milo principally endeavours to prove. This is the main ſubject of that fine and beautiful oration. The whole of his diſcourſe is to be conſidered as centering at laſt in this one point. Whatever different matters are occaſionally mentioned, will, if cloſely attended to, be found to have been introduced ſome way or other the better to ſupport and carry on this deſign. Now in ſuch caſes, where the fact is not denied, but ſomething is offered in its defence, the ſtate of the cauſe is taken from the defendant's plea, who is obliged to make it good: As in the inſtance here given, the chief point in diſpute was the lawfulneſs of Milo's action, which it was Cicero's buſineſs to demonſtrate. But when the defendant denies the fact, the ſtate

of

of the cause arises from the accusation; the proof of which then lies upon the plaintiff, and not, as in the former case, upon the defendant. So in the cause of Roscius, the charge made against him is, *That he killed his father*. But he denies the fact. The grand question therefore to be argued is, *Whether or not he killed his father*: The proof of this lay upon his accusers. And Cicero's design in his defence of him is to show, that they had not made good their charge. But it sometimes happens, that the defendant neither absolutely denies the fact, nor attempts to justify it; but only endeavours to qualify it, by denying that it is a crime of that nature, or deserves that name, by which it is expressed in the charge. We have an example of this proposed by Cicero: " A person is accused of sacrilege, for taking a thing, that was sacred, out of a private house. He owns the fact, but denies it to be sacrilege; since it was committed in a private house, and not in a temple." Hence this question arises, *Whether to take a sacred thing out of a private house, is to be deemed sacrilege, or only simple theft?* It lies, upon the accuser to prove what the other denies; and therefore the state of the cause is here also, as well as in the preceding case, taken from the indictment.

But besides the principal question, there are other subordinate questions, which follow upon it in the course of a dispute, and should be carefully distinguished from it. Particularly that which arises from the reason, or argument, which is brought in proof of the principal question. For the principal question itself proves nothing, but is the thing to be proved, and becomes at last the conclusion of the discourse. Thus, in the cause of Milo, his argument is, *I killed Clodius justly, because he assassinated me.* Unless the Clodian party be supposed to deny this, they give up their cause. From hence therefore this subordinate question follows, *Whether Clodius assassinated Milo?* Now Cicero spends much time in the proof of this, as the hinge on which the first question, and consequently the whole cause, depended. For if this was once made to appear, the lawfulness of Milo's killing Clodius, which was the grand question or thing to be proved, might be inferred as an allowed consequence from it. This will be evident, by throwing Milo's argument, as used by Cicero, into the form of a syllogism.

An assassin is lawfully killed:
Clodius was an assassin:
Therefore he was lawfully killed by Milo whom he assassinated.

If the minor proposition of this syllogism was granted, no one would deny the conclusion: for the Roman law allowed of self-defence. But as Cicero was very sensible this would not be admitted, so he takes much pains to bring the court into the belief of it. Now where the argument brought in defence of the second question is contested, or the orator supposes that it may be so, and therefore supports that with another argument, this occasions a third question consequent upon the former; and in like manner he may proceed to a fourth. But be they more or fewer, they are to be considered but as one chain of subordinate questions dependent upon the first. And though each of them has its particular state, yet none of these is what rhetorician call *The state of the Cause*, which is to be understood only of the principal question. And if, as it frequently happens, the first or principal question is itself directly proved from more than one argument; this makes no other difference, but that each of these arguments, so far as they are followed by others to support them, become a distinct series of subordinate questions, all dependent upon the first. As when Cicero endeavours to prove, that Roscius did not kill his father, from two reasons or arguments: *Because he had neither any cause to move him to such a barbarous action, nor any opportunity for it.*

Moreover, besides these subordinate questions, there are also incidental ones often introduced, which have some reference to the principal question, and contribute towards the proof of it, though they are not necessarily connected with it, or dependent upon it. And each of these also has its state, though different from that of the cause. For every question, or point of controversy, must be stated, before it can be made the subject of disputation. And it is for this reason, that every new argument advanced by an orator is called a *question*; because it is considered as a fresh matter of controversy. In Cicero's defence of Milo, we meet with several of this sort of questions, occasioned by some aspersions which had been thrown out by the Clodian party to the prejudice of Milo. As, " That he was unworthy to see the light, who owned he had killed a man:" For Milo before his trial had openly confessed he killed Clodius. So likewise, " That the senate had declared the killing of Clodius was an illegal action." And further, " That Pompey, by making a new law to settle the manner of Milo's trial, had given his judgment against Milo." Now to each of these Cicero replies, before he proceeds to the principal question. And therefore, though the question, in which the state of a controversy consists, is said by Quintilian to arise from " the first conflict of causes," yet we find by this instance of Cicero, that it is not always the first question in order, upon which the orator treats.

But it sometimes happens, that the same cause or controversy contains in it more than one state. Thus in judicial causes, every distinct charge occasions a new state. All Cicero's orations against Verres relate to one cause, founded upon a law of the Romans against unjust exactions made by their governors of provinces upon the inhabitants; but as that prosecution is made up of as many charges as there are orations, every charge, or indictment, has its different state. So likewise his oration in defence of Cœlius has two states, in answer to a double charge made against him by his adversaries: one, " for borrowing money of Clodia, in order to bribe certain slaves to kill a foreign ambassador;" and the other, " for an attempt afterwards to poison Clodia herself." Besides which, there were several other matters of a less heinous nature, which had been thrown upon him by his accusers, with a design, very likely, to render the two principal charges more credible; to which Cicero first replies, in the same manner as in his defence of Milo.

Though all the examples we have hitherto brought to illustrate this subject have been taken from judicial cases, yet not only these, but very frequently discourses of the deliberative kind, and sometimes those of the demonstrative, are managed in a controversial way.

And

And all controverſies have their ſtate. And therefore Quintilian very juſtly obſerves, that "ſtates belong both to general and particular queſtions; and to all ſorts of cauſes, demonſtrative, deliberative, and judicial." In Cicero's oration for the Manilian law, this is the main point in diſpute between him and thoſe who oppoſed that law: "Whether Pompey was the fitteſt perſon to be intruſted with the management of the war againſt Mithridates?" This is a ſubject of the deliberative kind. And of the ſame nature was that debate in the ſenate concerning the demolition of Carthage. For the matter in diſpute between Cato, who argued for it, and thoſe who were of the contrary opinion, ſeems to have been this: "Whether it was for the intereſt of the Romans to demoliſh Carthage?" And ſo likewiſe in thoſe two fine orations of Cato and Cæſar, given us by Salluſt, relating to the conſpirators with Catiline, who were then in cuſtody, the controverſy turns upon this: "Whether thoſe priſoners ſhould be puniſhed with death, or perpetual impriſonment?" Examples of the demonſtrative kind are not ſo common; but Cicero's oration concerning the 'Anſwers of the ſoothſayers,' may afford us an inſtance of it. Several prodigies had lately happened at Rome; upon which the ſoothſayers being conſulted, aſſigned this as the reaſon of them, Becauſe ſome places conſecrated to the gods had been afterwards converted to civil uſes. Clodius charged this upon Cicero; whoſe houſe was rebuilt at the public expence, after it had been demoliſhed by Clodius, and the ground conſecrated to the goddeſs Liberty. Cicero in this oration retorts the charge; and ſhows that the prodigies did not reſpect him, but Clodius. So that the queſtion in diſpute was, "To which of the two thoſe prodigies related?" This oration does not appear to have been ſpoken in a judicial way, and muſt therefore belong to the demonſtrative kind. His invective againſt Piſo is likewiſe much of the ſame nature, wherein he compares his own behaviour and conduct with that of Piſo.

As to the number of theſe ſtates, both Cicero and Quintilian reduce them to three. "We muſt (ſays Quintilian) agree with thoſe whoſe authority Cicero follows, who tells us, that three things may be inquired into in all diſputes: Whether a thing is; what it is; and how it is. And this is the method which nature preſcribes. For, in the firſt place, it is neceſſary the thing ſhould exiſt about which the diſpute is: becauſe no judgment can be made either of its nature or quality till its exiſtence be manifeſt; which is therefore the firſt queſtion. But though it be manifeſt that a thing is, it does not preſently appear what it is; and when this is known, the quality yet remains: and after theſe three are ſettled, no further inquiry is neceſſary." Now the firſt of theſe three ſtates is called the *conjectural ſtate;* as if it be inquired, "Whether one perſon killed another?" This always follows upon the denial of a fact by one of the parties; as was the caſe of Roſcius. And it receives its name from hence, that the judge is left, as it were, to conjecture, whether the fact was really committed or not, from the evidence produced on the other ſide. The ſecond is called the *definitive ſtate,* when the fact is not denied; but the diſpute turns upon the nature of it, and what name it is proper to give it: as in that example of Cicero, "Whether to take a ſacred thing out of a private houſe be theft or ſacrilege?" For in this caſe it is neceſſary to ſettle the diſtinct notion of thoſe two crimes, and ſhow their difference. The third is called the *ſtate of quality;* when the contending parties are agreed both as to the fact, and the nature of it; but the diſpute is, "Whether it be juſt or unjuſt, profitable or unprofitable, and the like;" as in the cauſe of Milo.

From what has been ſaid upon this ſubject, the uſe of it may in a good meaſure appear. For whoever engages in a controverſy, ought in the firſt place to conſider with himſelf the main queſtion in diſpute, to fix it well in his mind, and keep it conſtantly in his view; without which he will be very liable to ramble from the point, and bewilder both himſelf and his hearers. And it is no leſs the buſineſs of the hearers principally to attend to this; by which means they will be helped to diſtinguiſh and ſeparate from the principal queſtion what is only incidental, and to obſerve how far the principal queſtion is affected by it; to perceive what is offered in proof, and what is only brought in for illuſtration; not to be miſled by digreſſions, but to diſcern when the ſpeaker goes off from his ſubject, and when he returns to it again; and, in a word, to accompany him through the whole diſcourſe, and carry with them the principal chain of reaſoning upon which the cauſe depends, ſo as to judge upon the whole, whether he has made out his point, and the concluſion follows from the premiſes.

Chap. II. *Of Arguments ſuited to Demonſtrative Diſcourſes.*

16 Of arguments ſuited to demonſtrative diſcourſes.

These conſiſt either in praiſe or diſpraiſe; and, agreeably to the nature of all contraries, one of them will ſerve to illuſtrate the other.

Now we either praiſe *perſons* or *things.*

I. In praiſing or diſpraiſing *perſons,* rhetoricians preſcribe two methods. One is, to follow the order in which every thing happened that is mentioned in the diſcourſe; the other is, to reduce what is ſaid under certain general heads, without a ſtrict regard to the order of time.

1. In purſuing the former method, the diſcourſe may be very conveniently divided into three periods. The firſt of which will contain what preceded the perſon's birth; the ſecond, the whole courſe of his life; and the third what followed upon his death.

Under the firſt of theſe may be comprehended what is proper to be ſaid concerning his country or family. And therefore, if theſe were honourable, it may be ſaid to his advantage, that he nowiſe diſgraced them, but acted ſuitably to ſuch a deſcent. But if they were not ſo, they may be either wholly omitted; or it may be ſaid, that, inſtead of deriving thence any advantage to his character, he has conferred a laſting honour upon them; and that it is not of ſo much moment where, or from whom, a perſon derives his birth, as how he lives.

In the ſecond period, which is that of his life, the qualities both of his mind and body, with his circumſtances in the world, may be ſeparately conſidered. Though, as Quintilian rightly obſerves, "All external advantages are not praiſes for themſelves, but according to the uſe that is made of them. For riches, and power, and intereſt, as they have great influence, and may be applied either to good or bad purpoſes, are a a proof of the temper of our minds; and therefore we are either made better or worſe by them." But theſe things are a juſt ground for commendation, when they are the reward of virtue or induſtry. Bodily endowments are health, ſtrength, beauty, activity, and the like; which are more or leſs commendable, according as they are employed. And where theſe, or any of them, are wanting, it may be ſhown, that they are abundantly compenſated by the more valuable endowments of the mind. Nay, ſometimes a defect in theſe may give an advantageous turn to a perſon's character; for any virtue appears greater, in proportion to the diſadvantages the perſon laboured under in exerting it. But the chief topics of praiſe are taken from the virtues and qualifications of the mind. And here the orator may conſider the diſpoſition, education, learning, and ſeveral virtues, which ſhone through the whole courſe of the perſon's life. In doing which, the preference ſhould always be given to virtue above knowledge or any other accompliſhment. And in actions, thoſe are moſt conſiderable, and will be heard with greateſt approbation, which a perſon either did alone, or firſt, or wherein he had feweſt aſſociates; as likewiſe thoſe which exceeded expectation, or were done for the advantage of others rather than his own. And further, as the laſt ſcene of a man's life generally commands the greateſt regard, if any thing remarkable at that time was either ſaid or done, it ought particularly to be mentioned. Nor ſhould the manner of his death, or cauſe of it, if accompanied with any commendable circumſtances be omitted; as if he died in the ſervice of his country, or in the purſuit of any other laudable deſign.

The third and laſt period relates to what followed after the death of the perſon. And here the public loſs, and public honours conferred upon the deceaſed, are proper to be mentioned. Sepulchres, ſtatues, and other monuments to perpetuate the memory of the dead, at the expence of the public, were in common uſe both among the Greeks and Romans. But in the earlieſt times, as theſe honours were more rare, ſo they were leſs coſtly. For as in one age it was thought a ſufficient reward for him who died in the defence of his country, to have his name cut in a marble inſcription, with the cauſe of his death; ſo in others it was very common to ſee the ſtatues of gladiators, and perſons of the meaneſt rank, erected in public places. And therefore a judgement is to be formed of theſe things from the time, cuſtom, and circumſtances, of different nations; ſince the frequency of them renders them leſs honourable, and takes off from their evidence as the rewards of virtue. But, as Quintilian ſays, "Children are an honour to their parents, cities to their founders, laws to thoſe who compiled them, arts to their inventors, and uſeful cuſtoms to the authors of them."

And this may ſuffice for the method of praiſing perſons, when we propoſe to follow the order of time, as Iſocrates has done in his funeral oration upon Evagoras king of Salamis, and Pliny in his panegyric upon the emperor Trajan. But as this method is very plain and obvious, ſo it requires the more agreeable dreſs to render it delightful; leſt otherwiſe it ſeem rather like a hiſtory than an oration: For which reaſon, we find, that epic poets, as Homer, Virgil, and others, begin with the middle of their ſtory, and afterwards take a proper occaſion to introduce what preceded, to diverſify the ſubject, and give the greater pleaſure and entertainment to their readers.

2. The other method above hinted was, to reduce the diſcourſe to certain general heads without regarding the order of time. As if any one, in praiſing the elder Cato, ſhould propoſe to do it, by ſhowing that he was a moſt prudent ſenator, an excellent orator, and moſt valiant general; all which commendations are given him by Pliny. In like manner, the character of a good general may be compriſed under four heads; ſkill in military affairs, courage, authority, and ſucceſs: from all which Cicero commends Pompey. And agreeably to this method Suetonius has written the lives of the firſt twelve Cæſars.

But in the praiſing of perſons, care ſhould always be taken to ſay nothing that may ſeem fictitious or out of character, which may call the orator's judgement or integrity in queſtion. It was not without cauſe, therefore, that Lyſippus the ſtatuary, as Plutarch tells us, blamed Apelles for painting Alexander the Great with thunder in his hand; which could never ſuit his character as a man, however he might boaſt of his divine deſcent: for which reaſon Lyſippus himſelf made an image of him holding a ſpear, as the ſign of a warrior. Light and trivial things in commendations are likewiſe to be avoided, and nothing mentioned but what may carry in it the idea of ſomething truly valuable, and which the hearers may be ſuppoſed to wiſh for, and is proper to excite their emulation. Theſe are the principal heads of praiſe with relation to men. In diſpraiſe, the heads contrary to theſe are requiſite; which being ſufficiently clear from what has been ſaid, need not particularly be inſiſted on.

II. We proceed therefore to the other part of the diviſion, which reſpects *things*, as diſtinguiſhed from perſons. By which we are to underſtand all beings inferior to man, whether animate or inanimate; as likewiſe the habits and diſpoſitions of men, either good or bad, when conſidered ſeparately, and apart from their ſubjects, as arts and ſciences, virtues and vices, with whatever elſe may be a proper ſubject for praiſe or diſpraiſe. Some writers, indeed, have, for their own amuſement and the diverſion of others, diſplayed their eloquence in a jocoſe manner upon ſubjects of this kind. So Lucian has written in praiſe of a fly, and Syneſius an elegant encomium upon baldneſs. Others, on the contrary, have done the like in a ſatirical way. Such is Seneca's apotheoſis or conſecration of the emperor Claudius; and the Myſopogon or beard-hater, written by Julian the emperor. Not to mention ſeveral modern authors, who have imitated them in ſuch ludicrous compoſitions. But as to theſe things, and all of the like nature, the obſervation of Antony in Cicero ſeems very juſt: "That it is not neceſſary to reduce every ſubject we diſcourſe upon to rules of art." For many are ſo trivial, as not to deſerve it; and others ſo plain and evident of themſelves, as not to require it. But ſince it frequently comes in the way both of orators and hiſtorians to deſcribe countries, cities, and facts, we ſhall briefly mention the principal heads of invention proper to illuſtrate each of theſe.

Countries, then, may be celebrated from the plea-

Invention.

santness of their situation, the clemency and wholesomeness of the air, and goodness of the soil; to which last may be referred the springs, rivers, woods, plains, mountains, and minerals. And to all these may be added their extent, cities, the number and antiquity of the inhabitants; their policy, laws, customs, wealth, character for cultivating the arts both of peace and war; their princes, and other eminent men they have produced. Thus Pacatus has given us a very elegant description of Spain, in this panegyric upon the emperor Theodosius, who was born there.

Cities are praised from much the same topics as countries. And here, whatever contributes either to their defence or ornament ought particularly to be mentioned; as the strength of the walls and fortifications, the beauty and splendour of the buildings, whether sacred or civil, public or private. We have in Herodotus a very fine description of Babylon, which was once the strongest, largest, and most regular city in the world. And Cicero has accurately described the city of Syracuse, in the island Sicily, in one of his orations against Verres.

But facts come much oftener under the cognizance of an orator. And these receive their commendation from their honour, justice, or advantage. But in describing them, all the circumstances should be related in their proper order: and that in the most lively and affecting manner suited to their different nature. Livy has represented the demolition of Alba by the Roman army, which was sent thither to destroy it, through the whole course of that melancholy scene, in a style so moving and pathetic, that one can hardly forbear condoling with the inhabitants, upon reading his account.

But in discourses of this kind, whether of praise or dispraise, the orator should (as he ought indeed upon all occasions) well consider where, and to whom, he speaks. For wise men often think very differently both of persons and things from the common people. And we find that learned and judicious men are frequently divided in their sentiments, from the several ways of thinking to which they have been accustomed. Besides, different opinions prevail, and gain the ascendant, at different times. While the Romans continued a free nation, love of their country, liberty, and public spirit, were principles in the highest esteem among them. And therefore, when Cato killed himself, that he might not fall into the hands of Cæsar, and survive the liberty of his country, it was thought an instance of the greatest heroic virtue; but afterwards, when they had been accustomed to an arbitrary government, and the spirit of liberty was now lost, the poet Martial could venture to say,

Death to avoid 'tis madness sure to die.

A prudent orator therefore will be cautious of opposing any settled and prevailing notions of those whom he addresses, unless it be necessary; and then he will do it in the softest and most gentle manner.

Chap. III. *Of Arguments suited to Deliberative Discourses.*

This kind of discourses must certainly have been very ancient; since, doubtless, from the first beginning of men's conversing together, they deliberated upon their common interest, and offered their advice to each other. But neither those of the laudatory nor judicial kind could have been introduced, till mankind were settled in communities, and found it necessary to encourage virtue by public rewards, and bring vice under the restraint of laws. The early practice of suasory discourses appears from sacred writ, where we find, that when Moses was ordered upon an embassy into Egypt, he would have excused himself for want of eloquence. And Homer represents the Greeks at the siege of Troy, as flocking like a swarm of bees to hear their generals harangue them. Nor is this part of oratory less conspicuous for its usefulness to mankind, than for its antiquity; being highly beneficial either in councils, camps, or any societies of men. How many instances have we upon record, where the fury of an enraged multitude has been checked and appeased by the prudent and artful persuasion of some particular person? The story of Agrippa Menenius, when the commons of Rome withdrew from the senators, and retired out of the city, is too well known to need reciting. And how often have armies been animated and fired to the most dangerous exploits, or recalled to their duty, when ready to mutiny, by a moving speech of their general? many instances of which we find in history.

17 Of deliberative discourses, and the arguments suited to them.

All deliberation respects something future, for it is in vain to consult about what is already past. The subject matter of it is, either things public or private, sacred or civil; indeed all the valuable concerns of mankind, both present and future, come under its regard. And the end proposed by this kind of discourses is chiefly profit or interest. But since nothing is truly profitable, but what is in some respect good; and every thing which is good in itself may not in all circumstances be for our advantage; properly speaking, what is both good and profitable, or beneficial good, is the end here designed. And therefore, as it sometimes happens, that what appears profitable may seem to interfere with that which is strictly just and honourable; in such cases it is certainly most adviseable to determine on the safer side of honour and justice, notwithstanding some plausible things may be offered to the contrary. But where the dispute lies apparently between what is truly honest, and some external advantage proposed in opposition to it, all good men cannot but agree in favour of honesty. Such was the case of Regulus, who, being taken prisoner by the Carthaginians, was permitted to go to Rome upon giving his oath, that unless he could persuade the senate to set at liberty some young Carthaginian noblemen, then prisoners at Rome, in exchange for him, he should return again to Carthage. But Regulus, when he came to Rome, was so far from endeavouring to prevail with the senate to comply with the desire of the Carthaginians, that he used all his interest to dissuade them from hearkening to the proposal. Nor could the most earnest entreaties of his nearest relations and friends, nor any arguments they were able to offer, engage him to continue at Rome, and not return again to Carthage. He had then plainly in his view, on the one side, ease, security, affluence, honours, and the enjoyment of his friends; and on the other, certain death, attended with cruel torments. However, thinking the former

former not consistent with truth and justice, he chose the latter. And he certainly acted as became an honest and brave man, in choosing death, rather than to violate his oath. Though whether he did prudently in persuading the senate not to make the exchange, or they in complying with him, we shall leave others to determine. Now, when it proves to be a matter of debate, whether a thing upon the whole be really beneficial or not; as here arise two parts, advice and dissuasion, they will each require proper heads of argument. But as they are contrary to each other, he who is acquainted with one, cannot well be ignorant of the other. We shall therefore chiefly mention those proper for advice, from whence such as are suited to dissuade will easily be perceived. Now the principal heads of this kind are these following, which are taken from the nature and properties of the thing itself under consideration.

1. *Pleasure* often affords a very cogent argument in discourses of this nature. Every one knows what an influence this has upon the generality of mankind. Though, as Quintilian remarks, pleasure ought not of itself to be proposed as a fit motive for action in serious discourses, but when it is designed to recommend something useful, which is the case here. So, would any one advise another to the pursuit of polite literature, Cicero has furnished him with a very strong inducement to it from the pleasure which attends that study, when he says, "If pleasure only was proposed by these studies, you would think them an entertainment becoming a man of sense and a gentleman. For other pursuits neither agree with all times, all ages, nor all places; but these studies improve youth, delight old age, adorn prosperity, afford a refuge and comfort in adversity, divert us at home, are no hinderance abroad, sleep, travel, and retire with us into the country."

2. *Profit*, or advantage. This has no less influence upon many persons than the former; and when it respects things truly valuable, it is a very just and laudable motive. Thus Cicero, when he sends his *Book of Offices* to his son, which he wrote in Latin for his use, advises him to make the best advantage both of his tutor's instructions and the conversation at Athens, where he then was; but withal to peruse his philosophical treatises, which would be doubly useful to him, not only upon account of the subjects, but likewise of the language, as they would enable him to express himself upon those arguments in Latin, which before had only been treated of in Greek.

3. *Honour*; than which no argument will sooner prevail with generous minds, or inspire them with greater ardour. Virgil has very beautifully described Hector's ghost appearing to Æneas the night Troy was taken, and advising him to depart, from this motive of honour:

> O goddess-born, escape by timely flight
> The flames and horrors of this fatal night.
> The foes already have possess'd the wall;
> Troy nods from high, and totters to her fall.
> Enough is paid to Priam's royal name;
> More than enough to duty and to fame.
> If by a mortal hand my father's throne
> Cou'd be defended, 'twas by mine alone.

The argument here made use of to persuade Æneas to leave Troy immediately, is, that he had done all that could be expected from him, either as a good subject or brave soldier, both for his king and country; which were sufficient to secure his honour; and now there was nothing more to be expected from him when the city was falling, and impossible to be saved; which, could it have been preserved by human power, he himself had done it.

But although a thing considered in itself appear beneficial if it could be attained, yet the expediency of undertaking it may still be questionable: in which case the following heads, taken from the circumstances which attend it, will afford proper arguments to engage in it.

(1.) The *possibility* of succeeding may sometimes be argued, as one motive to this end. So Hannibal endeavoured to convince King Antiochus, that it was possible for him to conquer the Romans, if he made Italy the seat of the war; by observing to him, not only that the Gauls had formerly destroyed their city, but that he had himself defeated them in every battle he fought with them in that country.

(2.) But an argument founded upon *probability* will be much more likely to prevail. For in many affairs of human life, men are determined either to prosecute them or not, as the prospect of success appears more or less probable. Hence Cicero, after the fatal battle at Pharsalia, dissuades those of Pompey's party, with whom he was engaged, from continuing the war any longer against Cæsar; because it was highly improbable, after such a defeat, by which their main strength was broken, that they should be able to stand their ground, or meet with better success than they had before.

(3.) But further, since probability is not a motive strong enough with many persons to engage in the prosecution of a thing which is attended with considerable difficulties, it is often necessary to represent the facility of doing it, as a further reason to induce them to it. And therefore Cicero makes use of this argument to encourage the Roman citizens in opposing Mark Antony (who upon the death of Cæsar had assumed an arbitrary power), by representing to them, that his circumstances were then desperate, and that he might easily be vanquished.

(4.) Again, If the thing advised can be shown to be in any respect necessary, this will render the motive still much stronger for undertaking it. And therefore Cicero joins this argument with the former, to prevail with the Roman citizens to oppose Antony, by telling them, that "The consideration before them was, not in what circumstances they should live, but whether they should live at all, or die with ignominy and disgrace." This way of reasoning will sometimes prevail when all others prove ineffectual. For some persons are not to be moved till things are brought to an extremity, and they find themselves reduced to the utmost danger.

(5.) To these heads may be added the consideration of the *event*, which in some cases carries great weight with it. As when we advise to the doing of a thing from this motive, That whether it succeed or not, it will yet be of service to undertake it. So after the great victory gained by Themistocles over the Persian fleet at the

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the ſtraits of Salamis, Mardonius adviſed Xerxes to return into Aſia himſelf, leſt the report of his defeat ſhould occaſion an inſurrection in his abſence: but to leave behind him an army of 300,000 men under his command; with which, if he ſhould conquer Greece, the chief glory of the conqueſt would redound to Xerxes; but if the deſign miſcarried, the diſgrace would fall upon his generals.

Theſe are the principal heads which furniſh the orator with proper arguments in giving advice. Cicero, in his oration for the Manilian law, where he endeavours to perſuade the Roman people to chooſe Pompey for their general in the Mithridatic war, reaſons from three of theſe topics, into which he divides his whole diſcourſe; namely, the neceſſity of the war, the greatneſs of it, and the choice of a proper general.— Under the firſt of theſe he ſhows, that the war was neceſſary, from four conſiderations; the honour of the Roman ſtate, the ſafety of their allies, their own revenues, and the fortunes of many of their fellow citizens, which were all highly concerned in it, and called upon them to put a ſtop to the growing power of King Mithridates, by which they were all greatly endangered. So that this argument is taken from the head of *neceſſity*. The ſecond, in which he treats of the greatneſs of the war, is founded upon the topic of *poſſibility*. For though he ſhows the power of Mithridates to be very great, yet not ſo formidable, but that he might be ſubdued; as was evident from the many advantages Lucullus had gained over him and his aſſociates. In the third head, he endeavours to prevail with them to intruſt the management of the war in the hands of Pompey, whom he deſcribes as a conſummate general, for his ſkill in military affairs, courage, authority, and ſucceſs; in all which qualities he repreſents him as ſuperior to any other of their generals whom they could at that time make choice of. The deſign of all which was, to perſuade them, that they had very good reaſon to hope for ſucceſs, and a happy event of the war, under his conduct. So that the whole force of his reaſoning under this head is drawn from *probability*. Theſe are the three general topics which make up that fine diſcourſe. Each of which is indeed ſupported by divers other arguments and conſiderations, which will be obvious in peruſing the oration itſelf, and therefore need not be here enumerated. On the contrary, in another oration he endeavours to diſſuade the ſenate from conſenting to a peace with Mark Antony, becauſe it was baſe, dangerous, and impracticable.

But no ſmall ſkill and addreſs are required in giving advice. For ſince the tempers and ſentiments of mankind, as well as their circumſtances, are very different and various; it is often neceſſary to accommodate the diſcourſe to their inclinations and opinions of things. And therefore the weightieſt arguments are not always the moſt proper and fitteſt to be uſed on all occaſions. Cicero, who was an admirable maſter of this art, and knew perfectly well how to ſuit what he ſaid to the taſte and reliſh of his hearers, in treating upon this ſubject, diſtinguiſhes mankind into two ſorts; the ignorant and unpoliſhed, who always prefer profit to honour; and ſuch as are more civilized and polite, who prefer honour and reputation to all other things.— Wherefore they are to be moved by theſe different views: Praiſe, glory, and virtue, influence the one: while the other is only to be engaged by a proſpect of gain and pleaſure. Beſides, it is plain, that the generality are much more inclined to avoid evils than to purſue what is good; and to keep clear of ſcandal and diſgrace, than to practiſe what is truly generous and noble. Perſons likewiſe of a different age act from different principles; young men for the moſt part view things in a different light from thoſe who are older and have had more experience, and conſequently are not to be influenced by the ſame motives.

Chap. IV. *Of Arguments ſuited to Judicial Diſcourſes.*

18 Of judicial diſcourſes and the arguments ſuited to them.

In *judicial* controverſies there are two parties; the plaintiff or proſecutor, and the defendant or perſon charged. The ſubject of them is always ſomething paſt. And the end propoſed by them Cicero calls *equity*, or *right* and *equity;* the former of which ariſes from the laws of the country, and the latter from reaſon and the nature of things. For at Rome the pretors had a court of equity, and were empowered, in many caſes relating to property, to relax the rigour of the written laws. But as this ſubject is very copious, and cauſes may ariſe from a great variety of things, writers have reduced them to three heads, which they call *ſtates*, to ſome one of which all judicial proceedings may be referred; namely, *whether a thing is*, *what it is*, or *how it is*. By the *ſtate* of a cauſe therefore is meant the principal queſtion in diſpute, upon which the whole affair depends. Which, if it ſtops in the firſt inquiry, and the defendant denies the fact, the ſtate is called *conjectural;* but if the fact be acknowledged, and yet denied to be what the adverſary calls it, it is termed *definitive;* but if there is no diſpute either about the fact or its name, but only the juſtice of it, it is called the *ſtate of quality:* as was ſhown more largely before (ſee N° 15.) But we there conſidered theſe ſtates only in a general view, and deferred the particular heads of argument proper for each of them to this *judicial* kind of diſcourſes; where they moſt frequently occur, and from which examples may eaſily be accommodated to other ſubjects.

All judicial cauſes are either *private* or *public*. Thoſe are called *private*, which relate to the right of particular perſons; and they are likewiſe called *civil* cauſes, as they are converſant about matters of property.— *Public* cauſes are thoſe which relate to public juſtice and the government of the ſtate; which are alſo called *criminal*, becauſe by them crimes are proſecuted, whether capital, or thoſe of a leſs heinous nature. We ſhall take the heads of the arguments only from this latter kind, becauſe they are more copious, and eaſy to be illuſtrated by examples; from which ſuch as agree to the former, namely, *civil* cauſes, will ſufficiently appear.

1. The *conjectural* ſtate. When the accuſed perſon denies the fact, there are three things which the proſecutor has to conſider; whether he *would* have done it, whether he *could*, and whether he *did* it. And hence ariſe three topics; from the *will*, the *power*, and the *ſigns* or circumſtances which attended the action. The affections of the mind diſcover the will; as paſſion, an old grudge, a deſire of revenge, a reſentment

fentment of an injury, and the like. Therefore Cicero argues from Clodius's hatred of Milo, that he defigned his death; and from thence infers, that he was the aggreffor in the combat between them, wherein Clodius was killed. This is what he principally endeavours to prove, and comes properly under this ftate: for Milo owned that he killed him, but alledged that he did it in his own defence. So that in regard to this point, which of them affaulted the other? the charge was mutual. The profpect of advantage may alfo be alledged to the fame purpofe. Hence it is faid of L. Caffius, that whenever he fat as judge in a cafe of murder, he ufed to advife and move the court to examine to whom the advantage arofe from the death of the deceafed. And Cicero puts this to Antony concerning the death of Cæfar. " If any one (fays he) fhould bring you upon trial, and ufe that faying of Caffius, *Cui bono?* ' Who got by it?' look to it, I befeech you, that you are not confounded. To thefe arguments may be added, hope of impunity, taken either from the circumftances of the accufed perfon, or of him who fuffered the injury. For perfons, who have the advantage of intereft, friends, power, or money, are apt to think they may eafily efcape; as likewife fuch who have formerly committed other crimes with impunity. Thus Cicero reprefents Clodius as hardened in vice, and above all the reftraint of laws, from having fo often efcaped punifhment upon committing the higheft crimes. On the contrary, fuch a confidence is fometimes raifed from the condition of the injured party, if he is indigent, obfcure, timorous, or deftitute of friends; much more if he has an ill reputation, or is loaded with popular hatred and refentment. It was this prefumption of the obfcurity of Rofcius, who lived in the country, and his want of intereft at Rome, which encouraged his accufers to charge him with killing his father, as Cicero fhows in his defence of him. Laftly, The temper of a perfon, his views, and manner of life, are confiderations of great moment in this matter. For perfons of bad morals, and fuch as are addicted to vice, are eafily thought capable of committing any wickednefs. Hence Salluft argues from the evil difpofition and vicious life of Catiline, that he affected to raife himfelf upon the ruins of his country.—The fecond head is the *power* of doing a thing: and there are three things which relate to this, the *place*, the *time*, and *opportunity*. As if a crime is faid to have been committed in a private place, where no other perfon was prefent; or in the night; or when the injured perfon was unable to provide for his defence. Under this head may likewife be brought in the circumftances of the perfons; as if the accufed perfon was ftronger, and fo able to overpower the other; or more active, and fo could eafily make his efcape. Cicero makes great ufe of this topic in the cafe of Milo, and fhows, that Clodius had all the advantages of *place*, *time*, and *opportunity*, to execute his defign of killing him. The third head comprehends the *figns* and circumftances which either preceded, accompanied, or followed, the commiffion of the fact. So threats, or the accufed perfon being feen at or near the place before the fact was committed, are circumftances that may probably precede murder; fighting, crying out, bloodfhed, are fuch as accompany it; palenefs, trembling, inconfiftent anfwers, hefitation, or faltering of the fpeech, fomething found upon the perfon accufed which belonged to the deceafed, are fuch as follow it. Thus Cicero proves, that Clodius had threatened the death of Milo, and given out that he fhould not live above three days at the fartheft.—Thefe arguments, taken from conjectures, are called *prefumptions*, which, though they do not directly prove that the accufed perfon committed the fact with which he is charged; yet when laid together, they appeared very ftrong, fentence by the Roman law might fometimes be given upon them, to convict him.

Thefe are the topics from which the profecutor takes his arguments. Now the bufinefs of the defendant is to invalidate thefe. Therefore fuch as are brought from the *will*, he either endeavours to fhow are not true, or fo weak as to merit very little regard. And he refutes thofe taken from the *power*, by proving that he wanted either opportunity or ability: as, if he can fhow, that neither the place nor time infifted on was at all proper; or that he was then in another place. In like manner he will endeavour to confute the *circumftances*, if they cannot be directly denied, by fhowing that they are not fuch as do neceffarily accompany the fact, but might have proceeded from other caufes, though nothing of what is alledged had been committed; and it will be of great fervice to affign fome other probable caufe. But fometimes the defendant does not only deny that he did the fact, but charges it upon another. Thus Cicero, in his oration for Rofcius, not only defends him from each of thefe three heads, but likewife charges the fact upon his accufers.

2. The *definitive* ftate, which is principally concerned in defining and fixing the name proper to the fact: though orators feldom make ufe of exact definitions, but commonly choofe larger defcriptions, taken from various properties of the fubject or thing defcribed.

The heads of argument in this ftate are much the fame to both parties. For each of them defines the fact his own way, and endeavours to refute the other's definition. We may illuftrate this by an example from Quintilian: " A perfon is accufed of facrilege, for ftealing money out of a temple, which belonged to a private perfon." The fact is owned; but the queftion is, *Whether it be properly facrilege?* The profecutor calls it fo, becaufe it was taken out of a temple. But fince the money belonged to a private perfon, the defendant denies it to be facrilege, and fays it is only fimple theft. Now the reafon why the defendant ufes this plea, and infifts upon the diftinction, is, becaufe by the Roman law the penalty of theft was only four times the value of what was ftolen; whereas facrilege was punifhed with death. The profecutor then forms his definition agreeable to his charge, and fays, " To fteal any thing out of a facred place is facrilege." But the defendant excepts againft this definition, as defective; and urges, that it does not amount to facrilege, unlefs the thing ftolen was likewife facred. And this cafe might once, perhaps, have been a matter of controverfy, fince we find it exprefsly determined in the Pandects, that " An action of facrilege fhould not lie, but only of theft, againft any one who fhould fteal the goods of private perfons depofited in a temple."

The fecond thing is the proof brought by each party to fupport his definition; as in the example given

given us by Cicero, of one "who carried his caufe by bribery, and was afterwards profecuted again upon an action of prevarication." Now, if the defendant was caft upon this action, he was, by the Roman law, fubjected to the penalty of the former profecution. Here the profecutor defines prevarication to be, *Any bribery or corruption in the defendant, with a defign to pervert juftice.* The defendant, therefore, on the other hand, reftrains it to *bribing only the profecutor.*

And if this latter fenfe agrees better with the common acceptation of the word, the profecutor in the third place pleads the intention of the law, which was to comprehend all bribery in judicial matters under the term of *prevarication.* In anfwer to which the defendant endeavours to fhow, either from the head of contraries, that a real profecutor and a prevaricator are ufed as oppofite terms in the law; or from the etymology of the word, that a prevaricator denotes one who pretends to appear in the profecution of a caufe, while in reality he favours the contrary fide; and confequently, that money given for this end only can, in the fenfe of the law, be called *prevarication.*

Laftly, The profecutor pleads, that it is unreafonable that he who does not deny the fact fhould efcape by a cavil about a word. But the defendant infifts upon his explication as agreeable to the law; and fays, the fact is mifreprefented and blackened, by affixing to it a wrong name.

3. The third ftate is that of *quality*, in which the difpute turns upon the juftice of an action. And here the defendant does not deny he did the thing he is charged with; but afferts it to be right and equitable, from the circumftances of the cafe, and the motives which induced him to it.

And, firft, He fometimes alledges, the reafon of doing it was in order to prevent fome other thing of worfe confequence, which would otherwife have happened. We have an inftance of this in the life of Epaminondas, who, with two other generals joined in the command with him, marched the Theban army into Peloponnefus againft the Lacedemonians; but by the influence of a contrary faction at home, their commiffions were fuperfeded, and other generals fent to command the army. But Epaminondas, being fenfible that, if he obeyed this order at that time, it would be attended with the lofs of the whole army, and confequently the ruin of the ftate, refufed to do it; and having perfuaded the other generals to do the like, they happily finifhed the war in which they were engaged; and upon their return home, Epaminondas taking the whole matter upon himfelf, on his trial was acquitted. The arguments proper in this cafe are taken from the juftice, ufefulnefs, or neceffity, of the action. The accufer therefore will plead, that the fact was not juft, profitable, nor neceffary, confidered either in itfelf or comparatively with that for the fake of which it is faid to have been done: and he will endeavour to fhew, that what the defendant affigns for the reafon of what he did might not have happened as he pretends. Befides, he will reprefent of what ill confequence it muft be, if fuch crimes go unpunifhed. The defendant, on the other hand, will argue from the fame heads, and endeavour to prove the fact was juft, ufeful, or neceffary. And he will further urge, that no juft eftimate can be made of any action, but from the circumftances which attend it; as the defign, occafion, and motives for doing it, which he will reprefent in the moft favourable light to his own caufe, and endeavour to fet them in fuch a view, as to induce others to think they could not but have done the fame in the like circumftances.

Again, The caufe of an action is fometimes charged by the defendant upon the party who received the damage, or fome other perfon, who either made it neceffary, or enjoined him to do it. The firft of thefe was Milo's plea for killing Clodius, becaufe he affaulted him with a defign to take away his life. Here the fact is not denied, as in the cafe of Rofcius abovementioned, under the *conjectural* ftate; but juftified from the reafon of doing it. For that an affaffin might be juftly killed, Cicero fhows both from law and reafon. The accufer, therefore, in fuch a cafe, will, if there be room for it, deny the truth of this allegation. So the friends of Clodius affirmed that Milo was the aggreffor, and not Clodius; which Cicero, in his defence of Milo, principally labours to refute. In the fecond cafe, the profecutor will fay, No one ought to offend becaufe another has offended firft; which defeats the courfe of public juftice, renders the laws ufelefs, and deftroys the authority of the magiftrate. The defendant, on the other hand, will endeavour to reprefent the danger and neceffity of the cafe, which required an immediate remedy, and in that manner; and urges, that it was vain and impracticable to wait for redrefs in the ordinary way, and therefore no ill confequence can arife to the public. Thus Cicero, in defending Sextius, who was profecuted for a riot in bringing armed men into the forum, fhows that his defign was only to repel force with force; which was then neceffary, there being no other means left for the people to affemble, who were excluded by a mob of the contrary party. Of the third cafe we have alfo an example in Cicero, who tells us, that, "in making a league between the Romans and Samnites, a certain young nobleman was ordered by the Roman general to hold the fwine (defigned for a facrifice); but the fenate afterwards difapproving the terms, and delivering up their general to the Samnites, it was moved, Whether this young man ought not likewife to be given up." Thofe who were for it might fay, that, to alledge the command of another, is not a fufficient plea for doing an ill action; and this is what the Roman law now exprefsly declares. But in anfwer to that, it might be replied, that it was his duty to obey the command of his general, who was anfwerable for his own orders, and not thofe who were obliged to execute them; and therefore, to give up this young nobleman would be to punifh one perfon for the fault of another.

Laftly, A fact is fometimes rather excufed than defended, by pleading that it was not done defignedly, or with any ill intent. This is called *conceffion*; and confifts of two parts, *apology* and *entreaty*. The former reprefents the matter as the effect of inadvertency, chance, or neceffity. Ariftotle gives us an example of inadvertency or imprudence in a woman at Athens, who gave a young man a love potion, which killed him; for which fhe was tried, but acquitted: though afterwards this was made criminal by the Roman law. The cafe of of Adraftus, as related by Herodotus, is an inftance of chance; who being intrufted by Crœfus with the care of his fon, as they were hunting, killed him accidentally with a javelin which he threw at a boar. It is neceffity, when a perfon excufes his making a default, from ftrefs of weather, ficknefs, or the like. Thus Cicero pleaded his illnefs, contracted by the fatigue of a long journey, as an excufe for not appearing in the fenate upon the fummons of Mark Antony, who threatened to oblige him to it by pulling his houfe down. But what the defendant here attributes to inadvertency, chance, or neceffity, the oppofite party will attribute to defign, negligence, or fome other culpable reafon; and reprefent it as a matter injurious to the public to introduce fuch precedents; and alfo produce inftances, if that can be done, where the like excufes have not been admitted. On the other hand, the defendant will infift on his innocence, and fhow the hardfhip and feverity of judging men's actions rather by the event, than from the intention: that fuch a procedure makes no difference between the innocent and the guilty; but muft neceffarily involve many honeft men in ruin and deftruction, difcourage all virtuous and generous defigns, and turn greatly to the prejudice of human fociety. He will alfo confider the inftances alledged by the accufer, and fhow the difference between them and his own cafe. And, laftly, He will have recourfe to entreaty, or a fubmiffive addrefs to the equity and clemency of the court, or party offended, for pardon; as Cicero has done in his oration to Cæfar, in favour of Ligarius.

Chap. V. *Of the Character and Addrefs of an Orator.*

19 Propriety of manners neceffary in in orator, both with refpect to character and addrefs.

Having confidered and explained the firft part of Invention, which furnifhes the orator with fuch arguments as are neceffary for the proof of his fubject, we are next to fhow what are the proper means to conciliate the minds of his hearers; to gain their affection; and to recommend both himfelf, and what he fays, to their good opinion and efteem. For the parts of invention are commonly thus diftinguifhed; that the firft refpects the *fubject* of the difcourfe, the fecond the *fpeaker*, and the third the *hearers*. Now the fecond of thefe, what we have at prefent to explain, is by Quintilian called a *propriety of manners*. And in order to exprefs this it is neceffary, as he tells us, "that every thing appear eafy and natural, and the difpofition of the fpeaker be difcovered by his words." We may form an eafy conception of this from the conduct of fuch perfons as are moft nearly concerned in each others welfare. As when relations or friends converfe together upon any affairs of importance, the temper and difpofition of the fpeaker plainly fhows itfelf by his words and manner of addrefs. And what nature here directs to without colouring or difguife, the orator is to endeavour to perform by his art. Though indeed, if what a perfon fays be inconfiftent with his ufual conduct and behaviour at other times, he cannot expect it fhould gain much credit, or make any deep impreffion upon his hearers; which may be one reafon why the ancient rhetoricians make it fo neceffary a qualification in an orator, that he be a good man; fince he fhould always be confiftent with himfelf, and, as we fay, talk in character. And therefore it is highly requifite, that he fhould not only gain the fkill of affuming thofe qualities which the nature and circumftances of his difcourfe require him to exprefs; but likewife, that he fhould ufe his utmoft endeavours to get the real habits implanted in his mind. For as by this means they will be always expreffed with greater eafe and facility; fo, by appearing conftantly in the courfe of his life, they will have more weight and influence upon particular occafions.

Now there are four qualities, more efpecially fuited to the character of an orator, which fhould always appear in his difcourfes, in order to render what he fays acceptable to his hearers; and thefe are *wifdom*, *integrity*, *benevolence*, and *modefty*.

1. *Wifdom* is neceffary; becaufe we eafily give into thofe whom we efteem wifer and more knowing than ourfelves. Knowledge is very agreeable and pleafant to all, but few make very great improvements in it; either by reafon they are employed in other neceffary affairs, and the mind of man cannot attend to many things at once; or becaufe the way to knowledge at firft is hard and difficult, fo that perfons either do not care to enter upon the purfuit of it, or, if they do, they are many times foon difcouraged, and drop it, for want of fufficient refolution to furmount its difficulties. Such, therefore, as either cannot, or do not care to give themfelves the trouble of examining into things themfelves, muft take up with the reprefentation of others; and it is an eafe to them to hear the opinion of perfons whom they efteem wifer than themfelves. No one loves to be deceived; and thofe who are fearful of being mifled, are pleafed to meet with a perfon in whofe wifdom, as they think, they can fafely truft. The character of wifdom therefore is of great fervice to an orator, fince the greater part of mankind are fwayed by authority rather than arguments.

2. But this of itfelf is not fufficient, unlefs the opinion of *integrity* be joined with it. Nay, fo far from it, that the greater knowledge and underftanding a man is fuppofed to have, unlefs he likewife have the character of an honeft man, he is often the more fufpected. For knowledge without honefty, is generally thought to difpofe a perfon, as well as qualify him, to deceive.

3. And to both thefe qualities the appearance of kindnefs and *benevolence* fhould likewife be added. For though a perfon have the reputation of wifdom and honefty, yet if we apprehend he is either not well affected to us, or at leaft regardlefs of our intereft, we are in many cafes apt to be jealous of him. Mankind are naturally fwayed by their affections, and much influenced through love or friendfhip; and therefore nothing has a greater tendency to induce perfons to credit what is faid, than intimations of affection and kindnefs. The beft orators have been always fenfible what great influence the expreffions of kindnefs and benevolence have upon the minds of others, to induce them to believe the truth of what they fay; and therefore they frequently endeavour to imprefs them with the opinion of it. Thus Demofthenes begins his celebrated oration for Ctefiphon. "It is my hearty prayer (fays he) to all the deities, that this my defence may be received by you with the fame affection which I have always expreffed for you and your city." And it is a very fine image of it which we have in Cicero, where,

Invention. where, in order to influence the judges in favour of Milo, he introduces him ſpeaking thus, as became a brave man, and a patriot, even upon the ſuppoſition he ſhould be condemned by them: "I bid my fellow citizens adieu: may they continue flouriſhing and proſperous; may this famous city be preſerved, my moſt dear country, however it has treated me; may my fellow citizens enjoy peace and tranquillity without me, ſince I am not to enjoy it with them, though I have procured it for them: I will withdraw, I will be gone."

4. *Modeſty.* It is certain, that what is modeſtly ſpoken is generally better received than what carries in it an air of boldneſs and confidence. Moſt perſons, though ignorant of a thing, do not care to be thought ſo; and would have ſome deference paid to their underſtanding. But he who delivers himſelf in an arrogant and aſſuming way ſeems to upbraid his hearers with ignorance, while he does not leave them to judge for themſelves, but dictates to them, and as it were demand their aſſent to what he ſays; which is certainly a very improper method to win upon them. For not a few, when convinced of an error in ſuch a way, will not own it; but will rather adhere to their former opinion, than ſeem forced to think right, when it gives another the opportunity of a triumph. A prudent orator therefore will behave himſelf with modeſty, that he may not ſeem to inſult his hearers; and will ſet things before them in ſuch an engaging manner, as may remove all prejudice either from his perſon or what he aſſerts. This is particularly neceſſary in the exordium of a diſcourſe. If the orator ſet out with an air of arrogance and oſtentation, the ſelf-love and pride of the hearers will be preſently awakened, and will follow him with a very ſuſpicious eye throughout all his progreſs. His modeſty ſhould diſcover itſelf not only in his expreſſions at the beginning, but in his whole manner; in his looks, in his geſtures, in the tone of his voice. Every auditory take in good part thoſe marks of reſpect and awe, which are paid to them by one who addreſſes them. Indeed the modeſty of an introduction ſhould never betray any thing mean or abject. It is always of great uſe to an orator, that together with modeſty and deference to his hearers, he ſhould ſhow a certain ſenſe of dignity, ariſing from a perſuaſion of the juſtice or importance of the ſubject of which he is to ſpeak. For to ſpeak timorouſly, and with heſitation, deſtroys the credit of what is offered; and ſo far as the ſpeaker ſeems to diſtruſt what he ſays himſelf, he often induces others to do the like.

But, as has been ſaid already, great care is to be taken that theſe characters do not appear feigned and counterfeit. For what is fictitious can ſeldom be long concealed. And if this be once diſcovered, it makes all that is ſaid ſuſpected, how ſpecious ſoever it may otherwiſe appear.

It is further neceſſary, that the orator ſhould know the world, and be well acquainted with the different tempers and diſpoſitions of mankind. Nor indeed can any one reaſonably hope to ſucceed in this province, without well conſidering the circumſtances of time and place, with the ſentiments and diſpoſitions of thoſe to whom he ſpeaks; which, according to Ariſtotle, may be diſtinguiſhed four ways, as they diſcover themſelves by the ſeveral *affections*, *habits*, *ages*, and *fortunes*, of mankind. And each of theſe require a different conduct and manner of addreſs.

2

Invention.

The *affections* denote certain emotions of the mind, which, during their continuance, give a great turn to the diſpoſition. For love prompts to one thing, and hatred to another. The like may be ſaid of anger, lenity, and the reſt of them.

Perſons differ likewiſe according to the various *habits* of their mind. So a juſt man is inclined one way, and an unjuſt man another; a temperate man to this, and an intemperate man to the contrary.

And as to the ſeveral *ages* of men, Ariſtotle has deſcribed them very accurately; and how perſons are differently affected in each of them. He divides the lives of men, conſidered as hearers, into three ſtages; youth, middle age, and old age.—Young men, he ſays, have generally ſtrong paſſions, and are very eager to obtain what they deſire, but are likewiſe very mutable, ſo that the ſame thing does not pleaſe them long. They are ambitious of praiſe, and quick in their reſentments: laviſh of their money, as not having experienced the want of it: frank and open, becauſe they have not often been deceived; and credulous for the ſame reaſon. They readily hope the beſt, becauſe they have not ſuffered much, and are therefore not ſo ſenſible of the uncertainty of human affairs; for which reaſon they are likewiſe more eaſily deceived. They are modeſt, from their little acquaintance with the world. They love company and cheerfulneſs, from the briſkneſs of their ſpirits. In a word, they generally exceed in what they do; love violently, hate violently, and act in the ſame manner through the reſt of their conduct.—The diſpoſition of old men is generally contrary to the former. They are cautious, and enter upon nothing haſtily; having in the courſe of many years been often impoſed upon; having often erred, and experienced the prevailing corruption of human affairs; for which reaſon they are likewiſe ſuſpicious, and moderate in their affections either of love or hatred. They purſue nothing great and noble, and regard only the neceſſaries of life. They love money; having learned by experience the difficulty of getting it, and how eaſily it is loſt. They are fearful, which makes them provident. Commonly full of complaints, from bodily infirmities, and a deficiency of ſpirits. They pleaſe themſelves rather with the memory of what is paſt, than with any future proſpect; having ſo ſhort a view of life before them, in compariſon of what is already gone: for which reaſon alſo, they love to talk of things paſt; and prefer them to what is preſent, of which they have but little reliſh, and know they muſt ſhortly leave them. They are ſoon angry, but not to exceſs. Laſtly, They are compaſſionate, from a ſenſe of their own infirmities, which makes them think themſelves of all perſons moſt expoſed.—Perſons of a middle age, betwixt theſe two extremes, as they are freed from the raſhneſs and temerity of youth, ſo they have not yet ſuffered the decays of old age. Hence in every thing they generally obſerve a better conduct. They are neither ſo haſty in their aſſent as the one, nor ſo minutely ſcrupulous as the other, but weigh the reaſons of things. They regard a decency in their actions; are careful and induſtrious; and as they undertake what appears juſt and laudable upon better and more deliberate conſideration than young perſons, ſo they purſue them

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them with more vigour and reſolution than thoſe who are older.

As to the different *fortunes* of mankind, they may be conſidered us noble, rich, or powerful; and the contrary to theſe.—Thoſe of high birth, and noble extraction, are generally very tender of their honour, and ambitious to increaſe it; it being natural for all perſons to deſire an addition to thoſe advantages of which they find themſelves already poſſeſſed. And they are apt to conſider all others as much their inferiors, and therefore expect great regard and deference ſhould be ſhown them.—Riches, when accompanied with a generous temper, command reſpect, from the opportunities they give of being uſeful to others; but they uſually elate the mind, and occaſion pride. For as money is commonly ſaid to command all things, thoſe who are poſſeſſed of a large ſhare of it, expect others ſhould be at their beck: ſince they enjoy that which all deſire, and which moſt perſons make the main purſuit of their lives to obtain.—But nothing is more apt to ſwell the mind than power. This is what all men naturally covet, even when perhaps they would not uſe it. But the views of ſuch perſons are generally more noble and generous than of thoſe who only purſue riches and the heaping up of money. A ſtate contrary to theſe gives a contrary turn of mind; and in lower life, perſons diſpoſitions uſually differ according to their ſtation and circumſtances. A citizen and a courtier, a merchant and a ſoldier, a ſcholar and a peaſant, as their purſuits are different, ſo is generally their turn and diſpoſition of mind.

It is the orator's buſineſs, therefore, to conſider theſe ſeveral characters and circumſtances of life, with the different bias and way of thinking they give to the mind; that he may ſo conduct himſelf in his behaviour and manner of ſpeaking, as will render him moſt acceptable, and gain him the good eſteem of thoſe whom he addreſſes.

Chap. VI. *Of the Paſſions.*

20 It is neceſſary, though difficult, to engage the intereſt of the paſſions.

As it is often highly neceſſary for the orator, ſo it requires his greateſt ſkill, to engage the paſſions in his intereſt. Quintilian calls this *the ſoul and ſpirit of his art*. And, doubtleſs, nothing more diſcovers its empire over the minds of men, than this power to excite, appeaſe, and ſway their paſſions, agreeably to the deſign of the ſpeaker. Hence we meet with the characters of *admirable*, *divine*, and other ſplendid titles, aſcribed to eloquence by ancient writers. It has indeed been objected by ſome, that whatever high encomiums may be given of this art by the admirers of it, it is however diſingenuous to deceive and impoſe upon mankind, as thoſe ſeem to do, who, by engaging their paſſions, give a bias to their minds, and take them off from the conſideration of the truth; whereas every thing ſhould be judged of from the reaſons brought to ſupport it, by the evidence of which it ought to ſtand or fall. But, in anſwer to this, it may be conſidered that all fallacy is not culpable. We often deceive children for their good; and phyſicians ſometimes impoſe on their patients, to come at a cure. And why, therefore, when perſons will not be prevailed with by reaſon and argument, may not an orator endeavour, by engaging their paſſions, to perſuade them to that which is for their advantage? Beſides, Quintilian makes it a neceſſary qualification of an orator, that he be an honeſt man, and one who will not abuſe his art. But ſince thoſe of a contrary character will leave no methods untried in order to carry their point, it is requiſite for thoſe who deſign well to be acquainted with all their arts, without which they will not be a match for them; as in military affairs it is highly advantageous for the general of an army to get himſelf informed of all the deſigns and ſtratagems of the enemy, in order to counteract them. Indeed this part of oratory is not neceſſary at all times, nor in all places. The better prepared perſons are to conſider truth, and act upon the evidence of it, the leſs occaſion there appears for it. But the greater part of mankind either do not duly weigh the force of arguments, or refuſe to act agreeably to their evidence. And where this is the caſe, that perſons will neither be convinced by reaſon, nor moved by the authority of the ſpeaker, the only way left to put them upon action, is to engage their paſſions. For the paſſions are to the mind, what the wind is to a ſhip: they move, and carry it forward; and he who is without them, is in a manner without action, dull and lifeleſs. There is nothing great or noble to be performed in life wherein the paſſions are not concerned. The Stoics, therefore, who were for eradicating the paſſions, both maintained a thing in itſelf impoſſible, and which, if it was poſſible, would be of the greateſt prejudice to mankind. For while they appeared ſuch zealous aſſertors of the government of reaſon, they ſcarce left it any thing to govern; for the authority of reaſon is principally exerciſed in ruling and moderating the paſſions, which, when kept in a due regulation, are the ſprings and motives to virtue. Thus hope produces patience, and fear induſtry; and the like might be ſhown of the reſt. The paſſions therefore are not to be extirpated, as the Stoics aſſerted, but put under the direction and conduct of reaſon. Indeed where they are ungovernable, and reſiſt the controul of reaſon, they are, as ſome have fitly called them, *diſeaſes of the mind;* and frequently hurry men to vice, and the greateſt miſfortunes of life: juſt as the wind, when it blows moderately, carries on the ſhip; but if it be too boiſterous and violent, may overſet her. The charge therefore brought againſt this art, for giving rules to influence the paſſions, appears groundleſs and unjuſt; ſince the proper uſe of the paſſions is, not to hinder the exerciſe of reaſon, but engage men to act agreeably to reaſon. And if an ill uſe be ſometimes made of this, it is not the fault of the art but of the artiſt.

We ſhall here conſider the paſſions, as they may be ſeparately referred, either to *demonſtrative*, *deliberative*, or *judicial* diſcourſes; though they are not wholly confined to any of them.

21 Of the paſſions which may be referred to demonſtrative diſcourſes.

1. To the *demonſtrative* kind, we may refer *joy* and *ſorrow*, *love* and *hatred*, *emulation* and *contempt*.

Joy is an elation of the mind, ariſing from a ſenſe of ſome preſent good. Such a reflection naturally creates a pleaſant and agreeable ſenſation, which ends in a delightful calm and ſerenity. This is heightened by a deſcription of former evils, and a compariſon between them and the preſent felicity. Thus Cicero endeavours to excite in the minds of his fellow citizens the higheſt ſenſe of joy and delight at Catiline's departure from Rome, by repreſenting to them the imminent danger which threatened

threatened both them and the city while he continued among them.

Sorrow, on the contrary, is an uneasiness of mind arising from a sense of some present evil. This passion has generally a place in funeral discourses. And it may be heightened, like the former, by comparison, when any past happiness is set in opposition to a present calamity. Hence Cicero aggravates the sorrow at Rome occasioned by the death of Metellus, from his character, and great services to the public, while living.

Love excites us to esteem any person for some excellency, and to do him all the good in our power. It is distinguished from *friendship*, which is mutual; and therefore love may continue where friendship is lost; that is, the affection may remain on one side. And when we assist a person from no other motive but to do him a kindness, Aristotle calls this *good will*. Love takes its rise from a variety of causes. Generosity, benevolence, integrity, gratitude, courtesy, and other social virtues, are great incitements to love any one endued with such qualities. And persons generally love those who are of a like disposition with themselves, and pursue the same views. It is therefore the chief art of a flatterer to suit himself in every thing to the inclination of the person whose good graces he courts. When the orator would excite this affection towards any person, it is proper to show, that he is possessed of at least some, if not all, of these agreeable qualities. When the conspirators with Catiline were to be brought to justice, Cicero was very sensible of the envy he should contract on that account, and how necessary it was for him to secure the love of the Roman senate for his support and protection in that critical juncture. And this he endeavours to do in his fourth oration against Catiline, by representing to them in the most pathetic manner, that all the labours he underwent, the difficulties he conflicted with, and the dangers to which he was exposed on that account, were not for his own sake, but for their safety, quiet, and happiness.

Hatred is opposed to love, and produced by the contrary dispositions. And, therefore, persons hate those who never did them any injury, from the ill opinion they have of their base and vicious inclinations. So that the way to excite this passion is by showing that any one has committed some heinous fact with an ill intent. And the more nearly affected persons are by such actions, in what they account of the greatest concern, the higher in proportion their hatred rises. Since life, therefore, is esteemed the most valuable good, Cicero endeavours to render Mark Antony odious to the citizens of Rome, by describing his cruelty.

Emulation is a disquiet, occasioned by the felicity of another, not because he enjoys it, but because we desire the like for ourselves. So that this passion is in itself good and laudable, as it engages men to pursue those things which are so. For the proper objects of emulation are any advantages of mind, body, or fortune, acquired by study or labour.

Emulation therefore is excited by a lively representation of any desirable advantages which appear to be attainable, from the example of others who are or have been possessed of them. But where the felicity of another occasions an uneasiness, not from the want of it, but, because he enjoys it, this passion is called *envy*, which the ancients describe as a hideous monster, feeding upon itself, and being its own tormentor. Aristotle justly observes, that it most usually affects such persons as were once upon a level with those they envy. For most men naturally think so well of themselves, that they are uneasy to see those who were formerly their equals advanced above them. But as this is a base and vicious passion, the orator is not to be informed how to excite it, but how to lessen or remove it. And the method prescribed by Cicero for this purpose is, to show that the things which occasioned it have not happened to the envied person undeservedly but are the just reward of his industry or virtue; that he does not so much convert them to his own profit or pleasure, as to the benefit of others; and that the same pains and difficulties are necessary to preserve them with which they were at first acquired.

Contempt is opposed to *emulation*, and arises from misconduct in things not of themselves vicious: As where a person either acts below his station and character, or affects to do that for which he is not qualified. Thus Cicero endeavours to expose Cæcilius, and bring him into contempt of the court, for pretending to rival him in the accusation of Verres, for which he was altogether unfit.

22
Of the passions which may be referred to deliberative discourses.

2. To *deliberative* discourses may be referred *fear*, *hope*, and *shame*.

Fear arises from the apprehension of some great and impending evil. For the greatest evils, while they appear at a distance, do not much affect us. Such persons occasion fear, who are possessed of power, especially if they have been injured, or apprehend so: likewise those who are addicted to do injuries, or who bear us an ill will. And the examples of others, who have suffered in a like case, or from the same persons, help to excite fear. From the circumstances therefore either of the thing or person, it will not be difficult for the orator to offer such arguments as may be proper to awaken this passion. So Demosthenes, when he would persuade the Athenians to put themselves in a condition of defence against King Philip, enumerates the several acts of hostility already committed by him against the neighbouring states. And because men's private concerns generally more affect them than what relates to the public, it is proper sometimes to show the necessary connexion these have with each other, and how the ruin of one draws the other after it.

The contrary passion to *fear* is *hope*; which arises either from a prospect of some future good, or the apprehension of safety from those things which occasion our fear. Young persons are easily induced to hope the best, from the vigour of their spirits. And those who have escaped former dangers are encouraged to hope for the like success for the future. The examples of others also, especially of wise and considerate men, have often the same good effect. To find them calm and sedate when exposed to the like dangers naturally creates confidence and the hopes of safety. But nothing gives persons such firmness and steadiness of mind under the apprehension of any difficulties, as a consciousness of their own integrity and innocence. Let dangers come from what quarter they will, they are best

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prepared to receive them. They can calmly view an impending tempeſt, obſerve the way of its approach, and prepare themſelves in the beſt manner to avoid it. In Cicero's oration for the Manilian law, he encourages the Roman citizens to hope for ſucceſs againſt Mithridates, if they choſe Pompey for their general, from the many inſtances of his former ſucceſſes which he there enumerates.

Shame ariſes from the apprehenſion of thoſe things that hurt a perſon's character. *Modeſty* has been wiſely implanted in mankind by the great Author of nature, as a guardian of virtue, which ought for this reaſon to be cheriſhed with the greateſt care; becauſe, as Seneca has well obſerved, "if it be once loſt, it is ſcarce ever to be recovered." Therefore the true cauſe or foundation of ſhame is any thing baſe or vicious; for this wounds the character, and will not bear reflection. And he muſt arrive at no ſmall degree of inſenſibility, who can ſtand againſt ſuch a charge, if he be conſcious to himſelf that it is juſt. Therefore, to deter perſons from vicious actions, or to expoſe them for the commiſſion of them, the orator endeavours to ſet them in ſuch a light as may moſt awaken this paſſion, and give them the greateſt uneaſineſs by the reflection. And becauſe the bare repreſentation of the thing itſelf is not always ſufficient for this purpoſe, he ſometimes enforces it by enlarging the view, and introducing thoſe perſons as witneſſes of the fact for whom they are ſuppoſed to have the greateſt regard. Thus, when ſome of the Athenians, in an arbitration about certain lands which had been referred to them by the contending parties, propoſed it as the ſhorteſt way of deciding the controverſy, to take the poſſeſſion of them in their own hands; Cydias, a member of the aſſembly, to diſſuade them from ſuch an unjuſt action, deſired them to imagine themſelves at that time in the general aſſembly of the ſtates of Greece (who would all hear of it ſhortly), and then conſider how it was proper to act. But where perſons labour under an exceſs of modeſty which prevents them from exerting themſelves in things fit and laudable, it may ſometimes be neceſſary to ſhew that it is faulty and ill grounded. On the other hand, *immodeſty*, or impudence, which conſiſts in a contempt of ſuch things as affect the reputation, can never be too much diſcouraged and expoſed. And the way of doing this is to make uſe of ſuch arguments as are moſt proper to excite ſhame. We have a very remarkable inſtance of it in Cicero's ſecond Philippic, wherein he affixes this character upon Mark Antony through every ſcene of his life.

23
Of the paſſions which may be referred to *judicial* diſcourſes.

3 To *judicial* diſcourſes, may be referred *anger* and *lenity*, *pity* and *indignation*.

Anger is a reſentment, occaſioned by ſome affront or injury, done without any juſt reaſon. Now men are more inclined to reſent ſuch a conduct, as they think they leſs deſerve it. Therefore perſons of diſtinction and figure, who expect a regard ſhould be paid to their character, can the leſs bear any indications of contempt. And thoſe who are eminent in any profeſſion or faculty, are apt to be offended if reflections are caſt either upon their reputation or art. Magiſtrates alſo, and perſons in public ſtations, ſometimes think it incumbent on them to reſent indignities for the ſupport of their office. But nothing ſooner inflames this paſſion, than if good ſervices are rewarded with ſlights and neglect. The inſtance of Narſes, the Roman general, is remarkable in this kind; who, after he had been ſucceſsful in his wars with the Goths, falling under the diſpleaſure of the emperor Juſtin, was removed from the government of Italy, and received by the empreſs with this taunt, *That he muſt be ſent to weave among the girls;* which ſo provoked him, that he ſaid he would weave ſuch a web, as they would never be able to unravel. And accordingly, he ſoon after brought down the Longobards, a people of Germany, into Italy; where they ſettled themſelves in that part of the country, which from them is now called *Lombardy*. (See NARSES). The time and place in which an injury was done, and other circumſtances that attended it, may likewiſe contribute very much to heighten the fact. Hence Demoſthenes, in his oration againſt Midias, endeavours to aggravate the injury of being ſtruck by him, both as he was then a magiſtrate, and becauſe it was done at a public feſtival. From hence it appears, that the perſons who moſt uſually occaſion this paſſion are ſuch as neglect the rules of decency, contemn and inſult others, or oppoſe their inclinations; as likewiſe the ungrateful, and thoſe who violate the ties of friendſhip, or requite favours with injuries. But when the orator endeavours to excite anger, he ſhould be careful not to exceed due bounds in aggravating the charge, leſt what he ſays appear rather to proceed from prejudice, than a ſtrict regard to the demerit of the action.

Lenity is the remiſſion of anger. The deſigns of men's actions are principally to be regarded; and therefore what is done ignorantly, or through inadvertency, is ſooner forgiven. Alſo to acknowledge a fault, ſubmit, and aſk pardon, are the ready means to take off reſentment. For a generous mind is ſoon cooled by ſubmiſſion. Beſides, he who repents of his fault, does really give the injured party ſome ſatisfaction, by puniſhing himſelf; as all repentance is attended with grief and uneaſineſs of mind, and this is apt very much to abate the deſire of revenge. As, on the contrary, nothing is more provoking, than when the offender either audaciouſly juſtifies the fact, or confidently denies it. Men are likewiſe wont to lay aſide their reſentment, when their adverſaries happen by ſome other means to ſuffer what they think a ſufficient ſatisfaction. Laſtly, Eaſy circumſtances, a lucky incident, or any thing which gives the mind a turn to mirth and pleaſure, has a natural tendency to remove anger. For anger is accompanied with pain and uneaſineſs, which very ill ſuit joy and cheerfulneſs. The orator therefore, in order to aſſuage and pacify the minds of his auditors, will endeavour to leſſen their opinion of the fault, and by that means to take off the edge of their reſentment. And to this purpoſe, it will be proper either to repreſent that the thing was not deſigned, or that the party is ſorry for it; or to mention his former ſervices; as alſo to ſhow the credit and reputation which will be gained by a generous forgiveneſs. And this laſt topic is very artfully wrought up by Cicero, in his addreſs to Cæſar in favour of Ligarius.

Pity ariſes from the calamities of others, by reflecting, that we ourſelves are liable to the like misfortunes. So that evils, conſidered as the common lot of human nature, are principally the cauſe of pity. And this makes the difference between *pity* and *good will*, which ariſes merely from a regard to the circumſtances of thoſe who want

want our aſſiſtance. But conſidering the uncertainty of every thing about us, he muſt ſeem in a manner diveſted of humanity, who has no compaſſion for the calamities of others; ſince there is no affliction which happens to any man, but either that, or ſome other as great, may fall upon himſelf. But thoſe perſons are generally ſooneſt touched with this paſſion, who have met with misfortunes themſelves. And by how much greater the diſtreſs is, or by how much the perſon appears leſs deſerving it, the higher pity does it excite; for which reaſon, perſons are generally moſt moved at the misfortunes of their relations and friends, or thoſe of the beſt figure and character. The orator, therefore, in order to excite the greater pity, will endeavour to heighten the idea of the calamity, from the ſeveral circumſtances both of the thing itſelf and the perſon who labours under it. A fine example of this may be ſeen in Cicero's defence of Muræna, *Cap.* 40, &c.

Indignation, as oppoſed to *pity*, is an uneaſineſs at the felicity of another who does not ſeem to deſerve it. But this reſpects only external advantages, ſuch as riches, honours, and the like; for virtues cannot be the object of this paſſion. Ariſtotle therefore ſays, "that pity and indignation are generally to be found in the ſame perſons, and are both evidences of a good diſpoſition." Now the orator excites this paſſion, by ſhowing the perſon to be unworthy of that felicity which he enjoys. And as, in order to move compaſſion, it is ſometimes of uſe to compare the former happy ſtate of the perſon with his preſent calamity; ſo here, the greater indignation is raiſed, by comparing his former mean circumſtances with his preſent advancement: as Cicero does in the caſe of Vatinius.

Theſe are the paſſions with which an orator is principally concerned. In addreſſing to which, not only the greateſt warmth and force of expreſſion is often neceſſary; but he muſt likewiſe firſt endeavour to impreſs his own mind with the ſame paſſion he would excite in others.

A man may convince, and even perſuade others to act, by mere reaſon and argument. But that degree of eloquence which gains the admiration of mankind, and properly denominates one an orator, is never found without warmth or paſſion. Paſſion, when in ſuch a degree as to rouſe and kindle the mind, without throwing it out of the poſſeſſion of itſelf, is univerſally found to exalt all the human powers. It renders the mind infinitely more enlightened, more penetrating, more vigorous and maſterly, than it is in its calm moments. A man, actuated by a ſtrong paſſion, becomes much greater than he is at other times. He is conſcious of more ſtrength and force; he utters greater ſentiments, conceives higher deſigns, and executes them with a boldneſs and a felicity of which on other occaſions he could not think himſelf capable. But chiefly, with reſpect to perſuaſion, is the power of paſſion felt. Almoſt every man in paſſion is eloquent. Then he is at no loſs for words and arguments. He tranſmits to others, by a ſort of contagious ſympathy, the warm ſentiments which he feels; his looks and geſtures are all perſuaſive; and nature here ſhows herſelf infinitely more powerful than art. This is the foundation of that juſt and noted rule, *Si vis me flere, dolendum eſt primum ipſi tibi.*

The warmth, however, which we expreſs, muſt be ſuited to the occaſion and the ſubject; for nothing can be more prepoſterous than an attempt to introduce great vehemence into a ſubject, which is either of ſlight importance, or which, by its nature, requires to be treated of calmly. A temperate tone of ſpeech is that for which there is moſt frequent occaſion; and he who is on every ſubject paſſionate and vehement, will be conſidered as a bluſterer, and meet with little regard.

PART II. OF DISPOSITION.

AS *Invention* ſupplies the orator with neceſſary materials, ſo *Diſpoſition* directs him how to place them in the moſt proper and ſuitable order. Diſpoſition, therefore, conſidered as a part of oratory, naturally follows invention. And what is here chiefly intended by it is, the placing the ſeveral parts of a diſcourſe in a juſt method and dependence upon one another.

Writers are not all agreed in determining the parts of an oration; though the difference is rather in the manner of conſidering them, than in the things themſelves. But Cicero, whom we ſhall here follow, mentions ſix, namely, *Introduction*, *Narration*, *Propoſition*, *Confirmation*, *Confutation*, and *Concluſion*.

CHAP. I. *Of the Introduction.*

24 Introduction gains the hearts and attention of the audience, and gives a general notion of the ſubject.

THE deſign of this is to prepare the minds of the hearers for a ſuitable reception of the remaining parts that are to follow. And for this end, three things are requiſite; that the orator gain the *good opinion* of his hearers, that he ſecure their *attention*, and give them ſome *general notion* of his ſubject.

1. *Good opinion.* When the orator introduces his diſcourſe with his own perſon, he will be careful to do it with modeſty, and ſeem rather to extenuate his virtues and abilities, than to magnify them. And where the nature of the ſubject may ſeem to require it, he will endeavour to ſhow, that ſome juſt and good reaſon induced him to engage in it. We have a very fine example of this in Cicero's oration for the poet Aulus Licinius Archias, which begins thus: "If I have any natural genius, which I am ſenſible is very ſmall, or any ability in ſpeaking, wherein I own I have been very converſant; or any ſkill acquired from the ſtudy and precepts of the beſt arts, to which my whole life has been devoted; this Aulus Licinius has, in a particular manner, a right to demand of me the fruit of all theſe things. For as far back as I can remember, and call to mind what paſſed in my youth to the preſent time, he has been my chief adviſer and encourager both to undertake and purſue this courſe of ſtudies." When the orator ſets out with the perſons of thoſe to whom the diſcourſe is made, it is not unuſual to commend them for their virtues, and thoſe eſpecially which have a more immediate relation to the preſent ſubject. Thus Cicero begins his oration of thanks for the pardon of Marcellus, with an encomium upon the mildneſs, clemency, and wiſdom of Cæſar, to whom it was addreſſed.

But

Diſpoſition. But ſometimes the orator expreſſes his gratitude for paſt favours; as Cicero has done in his orations, both to the people and ſenate of Rome, after his return from baniſhment.—And at other times he declares his concern for them and their intereſt; in which manner Cicero begins his fourth oration againſt Catiline, which was made in the ſenate." "I perceive (ſays he) that all your countenances and eyes are turned on me; I perceive that you are ſolicitous, not only for your own danger, and that of the ſtate, but for mine likewiſe, if that ſhould be removed. Your affection for me is pleaſant in miſfortunes, and grateful in ſorrow; but I adjure you to lay it aſide, and, forgetting my ſafety, conſider yourſelves and your children." But in judicial caſes, both the character of the perſon whoſe cauſe he eſpouſes, and that of the adverſe party likewiſe, furniſh the orator with arguments for exciting the good will of his hearers: The former, by commemorating his virtues, dignity, or merits, and ſometimes his misfortunes and calamities. So Cicero, in his defence of Flaccus, begins his oration in commending him on the account of his ſervices done to the public, the dignity of his family, and his love to his country. And Demoſthenes, in his oration againſt Midias, ſets out with a recital of his vices, in order to recommend his own cauſe to the favourable opinion of the court.

2. *Attention*. On this head, Cicero ſays, "We ſhall be heard attentively on one of theſe three things; if we propoſe what is great, neceſſary, or for the intereſt of thoſe to whom the diſcourſe is addreſſed." So that, according to him, the topics of attention are much the ſame with thoſe of good opinion, when taken from the ſubject. And indeed, people are naturally led to attend either to thoſe things or perſons of which they have entertained a favourable opinion. But in order to gain this point, the orator ſometimes thinks it proper to requeſt the attention of his audience. Thus Cicero, in his defence of Cluentius, after having ſhown the heinouſneſs of the charge againſt him, concludes his introduction in the following manner, ſpeaking to the judges: "Wherefore I entreat, that while I briefly and clearly reply to a charge of many years ſtanding, you will, according to your uſual cuſtom, give me a kind and attentive hearing." And again, in his ſecond Philippic, addreſſing himſelf to the ſenate: "But as I muſt ſay ſomething for myſelf, and many things againſt Mark Antony; one of theſe I beg of you, that you will hear me kindly, while I ſpeak for myſelf; and the other I will undertake for, that when I ſpeak againſt him, you ſhall hear me with attention." But though the introduction be the moſt uſual and proper place for gaining attention, yet the orator finds it convenient ſometimes to quicken and excite his hearers in other parts of his diſcourſe, when he obſerves they flag, or has ſomething of moment to offer.

3. Some *general account* of the ſubject of the diſcourſe. This is always neceſſary; which the two others are not. And therefore it muſt be left to the prudence of the orator when to uſe or omit them as he ſhall judge proper, from the nature of his diſcourſe, the circumſtance of his hearers, and how he ſtands with them. But ſome account of the ſubject is what cannot be neglected. For every one expects to be ſoon informed of the deſign of the ſpeaker, and what he propoſes to treat of. Nor when they are all made uſe of, is it neceſſary they ſhould always ſtand in the order we have here placed them. Cicero ſometimes enters immediately upon his ſubject, and introduces the other heads afterwards. As in his third oration againſt Catiline, made to the body of the Roman people, which begins thus: "You ſee that the ſtate, all your lives, eſtates, fortunes, wives and children, and this ſeat of the greateſt empire, the moſt flouriſhing and beautiful city, having by the favour of heaven towards you, and my labours, counſels, and dangers, been this day reſcued from fire and ſword and the very jaws of deſtruction, are preſerved and reſtored to you." And then he proceeds to recommend himſelf to their eſteem and benevolence, from the conſideration of theſe benefits.

25 Introduction is not confined to theſe heads, but can admit of other matter, if furniſhed by the circumſtances of the caſe.

Theſe are the heads which commonly furniſh matter for this part of a diſcourſe. But orators often take occaſion from the time, place, largeneſs of the aſſembly, or ſome other proper circumſtance, to compliment their hearers, recommend themſelves, or introduce the ſubject upon which they are about to treat. Inſtances of each of theſe may be met with in ſeveral of Cicero's orations. And ſometimes they ſet out with ſome compariſon, ſimilitude, or other ornament, which they accommodate to the occaſion of their diſcourſe. Thus Iſocrates enters upon his celebrated panegyric in praiſe of his countrymen the Athenians with the following compariſon: "I have often wondered what could be their deſign who brought together theſe aſſemblies, and inſtituted the gymnaſtic ſports, to propoſe ſo great rewards for bodily ſtrength; and to vouchſafe no honour to thoſe who applied their private labours to ſerve the public, and ſo cultivated their minds as to be ſerviceable to others, to whom they ought to have ſhown greater regard. For although the ſtrength of a champion was doubled, no benefit would from thence accrue to others; but all enjoy the prudence of one man, who will hearken to his advice." In ſome caſes, orators have recourſe to a more covert and artful way of opening their ſubject, endeavour to remove jealouſies, apologize for what they are about to ſay, and ſeem to refer it to the candour of the hearers to judge of it as they pleaſe. Cicero appears to have been a perfect maſter of this art, and uſed it with great ſucceſs. Thus in his ſeventh Philippic, where he ſeems to expreſs the greateſt concern, leſt what he was about to ſay ſhould give any offence to the ſenate to whom he was ſpeaking: "I (ſays he) who always declared for peace, and to whom peace among ourſelves, as it is wiſhed for by all good men, was in a particular manner deſirable; who have employed all my induſtry in the forum, in the ſenate, and in the defence of my friends, whence I have arrived to the higheſt honours, a moderate fortune, and what reputation I enjoy; I therefore, who owe what I am to peace, and without it could not have been the perſon I am, be that what it will, for I would arrogate nothing to myſelf; I ſpeak with concern and fear, how you will receive what I am going to ſay; but I beg and entreat you, from the great regard I have always expreſſed for the ſupport and advancement of your honour, that if any thing ſaid by me ſhould at firſt appear harſh or unfit to be received, you will notwithſtanding pleaſe to hear it without offence, and not reject it till I have explained myſelf: I then, for I muſt repeat it again, who have always approved of peace, and promoted it, am againſt a peace with Mark Antony."

Disposition. Antony." This is called *insinuation;* and may be necessary, where a cause is in itself doubtful, or may be thought so from the received notions of the hearers, or the impressions already made upon them by the contrary side. An honest man would not knowingly engage in a bad cause; and yet, through prevailing prejudice, that may be so esteemed which is not so in itself. In these cases, therefore, great caution and prudence are necessary to give such a turn to things, and place them in that view as may be least liable to offence. And because it sometimes happens that the hearers are not so much displeased at the object as the person, Quintilian's rule seems very proper, when he says, "If the subject displease, the character of the person should support it; and when the person gives offence, he should be helped by the cause."

Chap. II. *Of Narration.*

26 Narration brings forward all those circumstances of a case, &c. in their proper and natural order, which are calculated to set it in a just or a strong light.

The orator having prepared his hearers to receive his discourses with candour and attention, and acquainted them with his general design in the introduction, before he proceeds directly to his subject, often finds it necessary to give some account of what preceded, accompanied, or followed upon it. And this he does in order to enlarge the view of the particular point in dispute, and place it in a clearer light. This is called *narration;* which is a recital of something done, in the order and manner in which it was done. Hence it is easy to perceive what those things are which properly enter into a narration. And such are the cause, manner, time, place, and consequences of an action; with the temper, fortune, views, ability, associates, and other circumstances of those concerned in it. Not that each of these particulars is necessary in every narration: but so many of them at least as are requisite to set the matter in a just light, and make it appear credible. Besides, in relating a fact, the orator does not content himself with such an account of it as is barely sufficient to render what he says intelligible to his hearers; but describes it in so strong and lively a manner, as may give the greatest evidence to his relation, and make the deepest impression upon their minds. And if any part of it appear at present less probable, he promises to clear up and remove any remaining doubts in the progress of his discourse. For the foundation of his reasoning afterwards is laid in the narration, from whence he takes his arguments for the confirmation. And therefore it is a matter of no small importance that this part be well managed, since the success of the whole discourse so much depends upon it. See Narration.

There are four properties required in a good narration; that it be short, clear, probable, and pleasant.

1. The *brevity* of a narration is not to be judged of barely from its length: for that may be too long, which contains but a little; and that too short, which comprehends a great deal. Wherefore this depends upon the nature of the subject, since some things require more words to give a just representation of them, and others fewer. That may properly therefore be called a *short narration*, which contains nothing that could well have been omitted, nor omits any thing which was necessary to be said. Now, in order to avoid both these extremes, care should be taken not to go farther back in the account of things, nor to trace them down lower, than the subject requires; to say that only in the general, which does not need a more particular explication; not to assign the causes of things, when it is enough to show they were done; and to omit such things as are sufficiently understood, from what either preceded, or was consequent upon them. But the orator should be careful, lest, while he endeavours to avoid prolixity, he run into obscurity. Horace was very sensible of this danger, when he said,

By striving to be short, I grow obscure.

2. *Perspicuity.* This may justly be esteemed the chief excellency of language. For as the design of speech is to communicate our thoughts to others, that must be its greatest excellence which contributes most to this end; and that, doubtless, is perspicuity. As perspicuity therefore is requisite in all discourse, so it is particularly serviceable in a narration, which contains the substance of all that is to be said afterwards. Wherefore, if this be not sufficiently understood, much less can those things which receive their light from it. Now the following things render a narration clear and plain: Proper and significant words, whose meaning is well known and determined; short sentences, though full and explicit, whose parts are not perplexed, but placed in their just order; proper particles to join the sentences, and show their connexion and dependence on each other; a due regard to the order of time, and other circumstances necessary to be expressed; and, lastly, suitable transitions.

3. *Probability.* Things appear probable when the causes assigned for them appear natural; the manner in which they are described is easy to be conceived; the consequences are such as might be expected; the characters of the persons are justly represented; and the whole account is well attested, consistent with itself, and agreeable to the general opinion. Simplicity likewise in the manner of relating a fact, as well as in the style, without any reserve or appearance of art, contributes very much to its credibility. For truth loves to appear naked and open, stript of all colouring or disguise. The conspiracy of Catiline was so daring and extravagant, that no one but such a desperado could ever have undertaken it with any hopes of success. However, Cicero's account of it to the senate was so full and exact, and so well suited to the character of the person, that it presently gained credit. And therefore, when upon the conclusion of Cicero's speech, Catiline, who was present, immediately stood up, and desired they would not entertain such hard thoughts of him, but consider how much his family had always been attached to the public interest, and the great services they had done the state; their resentment rose so high, that he could not be heard: upon which he immediately left the city, and went to his associates.

4. The last thing required in a narration is, that it be *pleasant* and *entertaining*. And this is more difficult, because it does not admit of that accurate composition and pompous dress which delight the ear, and recommend some other parts of a discourse. For it certainly requires no small skill in the speaker, while he endeavours to express every thing in the most natural, plain, and easy manner, not to grow flat and tiresome. For

For Quintilian's remark is very juſt, that "the moſt experienced orators find nothing in eloquence more difficult, than what all who hear it fancy they could have ſaid themſelves." And the reaſon of this ſeems very obvious. For as all art is an imitation of nature, the nearer it reſembles that, the more perfect it is in its kind. Hence unexperienced perſons often imagine that to be eaſieſt which ſuits beſt with thoſe natural ideas to which they have been accuſtomed; till, upon trial, they are convinced of their miſtake. Wherefore, to render this part of a diſcourſe pleaſant and agreeable, recourſe muſt be had to variety both in the choice of words and turns of the expreſſion. And therefore queſtions, admirations, interlocutions, imagery, and other familiar figures, help very much to diverſify and enliven a narration, and prevent it from becoming dull and tedious, eſpecially when it is carried on to any conſiderable length.

27 The uſes of narration.

Having given a brief account of the nature and properties of a narration, we ſhall now proceed to conſider the uſes of it.

Laudatory orations are uſually as it were a ſort of continued narration, ſet off and adorned with florid language and fine images proper to grace the ſubject, which is naturally ſo well fitted to afford pleaſure and entertainment. Wherefore a ſeparate narration is more ſuited to *deliberative* and *judicial* diſcourſes. In Cicero's oration for the Manilian law (which is of the former kind), the deſign of the narration is to ſhow the Roman people the neceſſity of giving Pompey the command of the army againſt King Mithridates, by repreſenting the nature of that war, which is done in the following manner: "A great and dangerous war (ſays he) threatens your revenues and allies from two very powerful kings, Mithridates and Tigranes; one of whom not being purſued after his defeat, and the other provoked, they think they have an opportunity to ſeize Aſia. Letters are daily brought from thoſe parts to worthy gentlemen of the equeſtrian order, who have large concerns there in farming your revenues: they acquaint me, as friends, with the ſtate of the public affairs, and danger of their own; that many villages in Bithynia, which is now your province, are burnt down; that the kingdom of Ariobarzanes, which borders upon your revenues, is entirely in the enemy's power; that Lucullus, after ſeveral great victories, is withdrawn from the war; that he who ſucceeds him is not able to manage it; that all the allies and Roman citizens wiſh and deſire the command of that war may be given to one particular perſon; and that he alone, and no other, is dreaded by the enemies. You ſee the ſtate of the caſe; now conſider what ought to be done." Here is an unhappy ſcene of affairs, which ſeemed to call for immediate redreſs. The cauſes and reaſons of it are aſſigned in a very probable manner, and the account well atteſted by perſons of character and figure. And what the conſequences would be, if not timely prevented, no one could well be ignorant. The only probable remedy ſuggeſted in general is, the committing that affair to one certain perſon, which he afterwards ſhows at large could be no other than Pompey. But in Cicero's defence of Milo (which is of the *judicial* kind), the deſign of the narration, which is greatly commended by Quintilian, is to prove that, in the combat between Clodius and Milo, the former was the aggreſſor. And in order to make this appear, he gives a ſummary account of the conduct of Clodius the preceding year; and from the courſe of his actions and behaviour, ſhows the inveterate hatred he bore to Milo, who obſtructed him in his wicked deſigns. For which cauſe he had often threatened to kill him, and given out that he ſhould not live beyond ſuch a time; and accordingly he went from Rome without any other apparent reaſon, but that he might have an opportunity to attack him in a convenient place near his own houſe, by which he knew Milo was then obliged to paſs. Milo was in the ſenate that day, where he ſtaid till they broke up, then went home, and afterwards ſet forward on his journey. When he came to the place in which he was to be aſſaulted, Clodius appeared every way prepared for ſuch a deſign, being on horſeback, and attended with a company of deſperate ruffians ready to execute his commands; whereas Milo was with his wife in a chariot, wrapped up in his cloak, and attended with ſervants of both ſexes. Theſe were all circumſtances which preceded the fact. And as to the action itſelf, with the event of it, the attack, as Cicero ſays, was begun by the attendants of Clodius from a higher ground, who killed Milo's coachman; upon which Milo, throwing off his cloak, leaped out, and made a brave defence againſt Clodius's men, who were got about the chariot. But Clodius, in the heat of the ſkirmiſh, giving out that Milo was killed, was himſelf ſlain by the ſervants of Milo, to avenge, as they thought, the death of their maſter. Here ſeems to be all the requiſites proper to make this account credible. Clodius's open and avowed hatred of Milo, which proceeded ſo far as to threaten his life; the time of his leaving Rome; the convenience of the place; his habit and company ſo different from thoſe of Milo; joined with his known character of a moſt profligate and audacious wretch, could not but render it very probable that he had formed that deſign to kill Milo. And which of them began the attack might very reaſonably be credited from the advanced ground on which Clodius and his men were placed; the death of Milo's coachman at the beginning of the combat; the ſkirmiſh afterwards at the chariot; and the reaſon of Clodius's own death at laſt, which does not appear to have been intended, till he had given out that Milo was killed.

But a diſtinct and ſeparate narration is not always neceſſary in any kind of diſcourſe. For if the matter be well known before, a ſet and formal narrative will be tedious to the hearers. Or if one party has done it already, it is needleſs for the other to repeat it. But there are three occaſions eſpecially, in which it may ſeem very requiſite: when it will bring light to the ſubject; when different accounts have already been given out concerning it; or when it has been miſrepreſented by the adverſe party. If the point in controverſy be of a dubious nature, or not ſufficiently known to the hearers, a diſtinct account of the matter, with the particular circumſtances attending it, muſt be very ſerviceable, in order to let them into a true ſtate of the caſe, and enable them to judge of it with greater certainty.

Moreover, where the oppoſite party has ſet the matter in a falſe light by ſome artful and invidious turn, or loaded it with any odious circumſtances, it ſeems no leſs neceſſary that endeavours ſhould be uſed to remove any ill impreſſions, which otherwiſe might remain upon the minds

Diſpoſition.

minds of the hearers, by a different and more favourable repreſentation. And if any thing can be fixed upon to make the contrary account appear abſurd or incredible, it ought particularly to be remarked. Thus Cicero, in his defence of Sextus Roſcius, ſhows that he was many miles diſtant from Rome at the time he was charged with having killed his father there. " Now (ſays he), while Sextus Roſcius was at Ameria, and this Titus Roſcius [*his accuſer*] at Rome, Sextus Roſcius [*the father*] was killed at the baths on Mount Palatine, returning from ſupper. From whence I hope there can be no doubt who ought to be ſuſpected of the murder. And, were not the thing plain of itſelf, there is this farther ſuſpicion to fix it upon the proſecutor; that, after the fact was committed, one Manlius Glaucia, an obſcure fellow, the freedman, client, and familiar, of this Titus Roſcius, firſt carried the account of it to Ameria, not to the ſon of the deceaſed, but to the houſe of Titus Capito his enemy;" with more to the ſame purpoſe. But what we bring it for is, to ſhow the uſe which Cicero makes of this narration for retorting the crime upon the proſecutors.

But the orator ſhould be very careful, in conducting this part, to avoid every thing which may prejudice the cauſe he eſpouſes. Falſehood, and a miſrepreſentation of facts, are not to be juſtified; but no one is obliged to ſay thoſe things which may hurt himſelf. We ſhall juſt mention one inſtance of this from Cicero, where he has ſhown great ſkill in this reſpect, in pleading before Cæſar for the pardon of Ligarius, who had joined with Pompey in the civil war. For Ligarius, having been repreſented by the adverſe party as an enemy to Cæſar, and ſo eſteemed by Cæſar himſelf; Cicero very artfully endeavours in his narration to take off the force of this charge, by ſhowing, that, when the war firſt broke out, he refuſed to engage in it; which he would not have done, had he borne any perſonal hatred to Cæſar. " Quintus Ligarius (ſays he), before there was any ſuſpicion of a war, went into Africa as a legate to the proconſul Caius Confidius; in which he ſo approved himſelf, both to the Roman citizens and allies, that, when Confidius left the province, the inhabitants would not be ſatisfied he ſhould leave the government in the hands of any other perſon. Therefore Quintus Ligarius having excuſed himſelf in vain for ſome time, accepted of the government againſt his will; which he ſo managed during the peace, that both the citizens and allies were greatly pleaſed with his integrity and juſtice. The war broke out on a ſudden, which thoſe in Africa did not hear of till it was begun: but upon the news of it, partly through inconſiderate haſte, and partly from blind fear, they looked out for a leader, firſt for their own ſafety, and then as they were affected; when Ligarius, thinking of home, and deſirous to return to his friends, would not be prevailed on to engage in any affairs. In the mean time, Publius Accius Varus, the prætor, who was formerly governor of Africa, coming to Utica, recourſe was immediately had to him, who very eagerly took upon himſelf the government; if that can be called a *government*, which was conferred on a private man by the clamour of the ignorant multitude, without any public authority. Ligarius, therefore, who endeavoured to avoid every thing of that kind, ceaſed to act ſoon after the arrival of Varus." Here Cicero ends his narrative. For though Ligarius afterwards joined with Pompey's party, yet to have mentioned that, which was nothing more than what many others had done, whom Cæſar had already pardoned, could have ſerved only to increaſe his diſpleaſure againſt him. And therefore he doubtleſs ſhowed great ſkill in ſo managing his account, as to take off the main force of the accuſation, and by that means make way for his pardon, which he accordingly obtained.

CHAP. III. *Of the Propoſition.*

28 The propoſition is a diſtinct and expreſs manner of laying down the ſubject on which an orator means to treat.

IN every juſt and regular diſcourſe, the ſpeaker's intention is to prove or illuſtrate ſomething. And when he lays down the ſubject upon which he deſigns to treat, in a diſtinct and expreſs manner, this is called the *propoſition*.

Orators uſe ſeveral ways in laying down the ſubject of their diſcourſes. Sometimes they do it in one general propoſition. We have an inſtance of this in Cicero's ſpeech to the ſenate, the day after Cæſar was killed (as it is given us by Dion Caſſius), in which his deſign was to perſuade them to peace and unanimity. " This (ſays he) being the ſtate of our affairs, I think it neceſſary that we lay aſide all the diſcord and enmity which have been among us, and return again to our former peace and agreement." And then he proceeds to offer his reaſons for this advice.

At other times, to give a clearer and more diſtinct view of their diſcourſe, they ſubjoin to the propoſition the general heads of argument by which they endeavour to ſupport it. This method Cicero uſes in his ſeventh Philippic, where he ſays, " I who have always commended and adviſed to peace, am againſt a peace with Mark Antony. But why am I averſe to peace? Becauſe it is baſe, becauſe it is dangerous, and becauſe it is impracticable. And I beſeech you to hear me with your uſual candour, while I make out theſe three things."

29 When the ſubject refers to ſeveral different things, and requires to be laid down in diſtinct propoſitions, it is called a *partition*.

But when the ſubject relates to ſeveral different things, which require each of them to be ſeparately laid down in diſtinct propoſitions, it is called a *partition*; though ſome have made two kinds of *partition*, one of which they call *ſeparation*, and the other *enumeration*. By the former of theſe, the orator ſhows in what he agrees with his adverſary, and wherein he differs from him. So, in the caſe formerly mentioned, of a perſon accuſed of ſacrilege for ſtealing private money out of a temple, he who pleads for the defendant ſays, " He owns the fact; but it being private money, the point in queſtion is, Whether this be ſacrilege?" And in the cauſe of Milo, Cicero, ſpeaking of Clodius, ſays, " The point which now comes before the court, is not, Whether he was killed or not; that we confeſs; but, Whether juſtly or unjuſtly." Now in reality here is no partition, ſince the former branch of the propoſition is what is agreed upon, and given up; and conſequently it is only the latter that remains to be diſputed. It is called *enumeration*, when the orator acquaints his hearers with the ſeveral parts of his diſcourſe upon which he deſigns to treat. And this alone, properly ſpeaking, is a *partition*. Thus Cicero ſtates his plea in his defence of Muræna: " I perceive the accuſation conſiſts of three parts: the firſt reſpects the conduct of his life; the ſecond his dignity; and the third contains a charge of bribery."

There are three things requiſite in a good partition;

Disposition. tion; that it be *short*, *complete*, and consist but of a *few members*.

A partition is said to be *short*, when each proposition contains in it nothing more than what is necessary. So that the brevity here required is different from that of a narration; for that consists chiefly in things, this in words. And, as Quintilian justly observes, brevity seems very proper here, where the orator does not show what he is then speaking of, but what he designs to discourse upon.

Again, It ought to be *complete* and perfect. And for this end, care must be taken to omit no necessary part in the enumeration.

But, however, there should be as *few heads* as is consistent with the nature of the subject. The ancient rhetoricians prescribe three or four at the most. And we do not remember that Cicero ever exceeds that number. But it is certain, the fewer they are, the better, provided nothing necessary be omitted. For too large a number is both difficult of retention, and apt to introduce that confusion which partition is designed to prevent.

Hitherto we have been speaking only of those heads into which the subject or general argument of the discourse is at first divided. For it is sometimes convenient to divide these again, or at least some of them, into several parts or members. And when this happens, it is best done, as the speaker comes to each of them in the order at first laid down; by which means the memory of the hearers will be less burdened than by a multitude of particulars at one and the same time. Thus Cicero, in his oration for the Manilian law, comprises what he designs to say under three general heads. "First (says he) I shall speak of the nature of the war, then of its greatness, and lastly about the choise of a general." And when he comes to the first of these, he divides it again into four branches; and shows, "how much the glory of the Romans, the safety of their allies, their greatest revenues, and the fortunes of many of their citizens, were all concerned in that war." The second head, in which he considers the greatness of the war, has no division. But when he comes to the third head, concerning the choice of a general, he divides that likewise into four parts; and shows, that so many virtues are necessary in a consummate general, such a one as was proper to have the management of that war, namely, *skill in military affairs*, *courage*, *authority*, and *success*: all which he attributes to Pompey. And this is the scheme of that celebrated oration.

This subdividing, however, should never have place but when it is absolutely necessary. To split a subject into a great many minute parts, by divisions and subdivisions without end, has always a bad effect in speaking. It may be proper in a logical treatise; but it makes an oration appear hard and dry, and unnecessarily fatigues the memory. In a sermon, there may be from three to five, or six heads, including subdivisions; seldom should there be more.

30 Negative and positive divisions of a subject.

Further, Some divide their subject into two parts, and propose to treat upon it *negatively* and *positively*; by showing first what it is not, and then what it is. But while they are employed to prove what it is not, they are not properly treating upon that, but something else; which seems as irregular as it is unnecessary. For he who proves what a thing is, does at the same time show what it is not. However, in fact, there is a sort of division by affirmation and negation, which may sometimes be conveniently used. As if a person, charged with killing another, should thus state his defence: *I had done right if I had killed him, but I did not kill him.* Here indeed, if the latter can be plainly made to appear, it may seem needless to insist upon the former. But if that cannot be so fully proved, but there may be room left for suspicion, it may be proper to make use of both: for all persons do not see things in the same light, and he who believes the fact, may likewise think it just; while he who thinks it unjust, may not believe it, but rather suppose, had it really been committed by the party, he would not have denied it, since he looked upon it as defensible. And this method of proceeding, Quintilian compares to a custom often used in traffic, when persons make a large demand at first, in order to gain a reasonable price. Cicero uses this way of reasoning in his defence of Milo; but in the contrary order; that is, he first answers the charge; and then justifies the fact, upon the supposition that the charge was true. For he proves, first, that Clodius was the aggressor; and not Milo, as the contrary party had asserted: and then, to give the greater advantage to his cause, he proceeds to show, that if Milo had been the aggressor, it would however have been a glorious action to take off such an abandoned wretch, who was not only a common enemy to mankind, but had likewise often threatened his life.

A good and just partition is attended with considerable advantages. For it gives both light and ornament to a discourse. And it is also a great relief to the hearers, who, by means of these stops and rests, are much better enabled to keep pace with the speaker without confusion, and by casting their thoughts either way, from what has been said, both know and are prepared for what is to follow. And as persons, in travelling a road with which they are acquainted, go on with greater pleasure and less fatigue, because they know how far it is to their journey's end; so to be apprised of the speaker's design, and the several parts of his discourse which he proposes to treat on, contributes very much to relieve the hearer, and keep up his attention. This must appear very evident to all who consider how difficult it is to attend long and closely to one thing, especially when we do not know how long it may be before we are like to be released. Whereas, when we are beforehand acquainted with the scheme, and the speaker proceeds regularly from one thing to another, opportunity is given to ease the mind, by relaxing the attention, and recalling it again when necessary. In a sermon, or in a pleading at the bar, few things are of greater consequence than a proper or happy division. It should be studied with much accuracy and care; for if one take a wrong method at first setting out, it will lead him astray in all that follows. It will render the whole discourse either perplexed or languid; and though the hearers may not be able to tell where the fault or disorder lies, they will be sensible there is a disorder somewhere, and find themselves little affected by what is spoken. The French writers of sermons study neatness and elegance in the division of their subjects much more than the English do; whose distributions, though sensible and just, yet are often inartificial and verbose.

Disposition.

Chap. IV. *Of Confirmation.*

31 Confirmation is used for the arguments brought in defence of a subject.

The orator having acquainted his hearers, in the proposition, with the subject on which he designs to discourse, usually proceeds either to prove or illustrate what he has there laid down. For some discourses require nothing more than an enlargement or illustration, to set them in a proper light, and recommend them to the hearers; for which reason, likewise, they have often no distinct proposition. But where arguments are brought in defence of the subject, this is properly *confirmation*. For, as Cicero defines it, " confirmation is that which gives proof, authority, and support to a cause, by reasoning." And for this end, if any thing in the proposition seems obscure, or liable to be misunderstood, the orator first takes care to explain it, and then goes on to offer such arguments for the proof of it, and represent them in such a light, as may be most proper to gain the assent of his hearers.

But here it is proper to observe, that there are different ways of reasoning suited to different arts. The mathematician treats his subject after another manner than the logician, and the orator in a method different from them both. Two methods of reasoning are employed by orators, the *synthetic and analytic*.

32 Synthetic reasoning may always be resolved into a syllogism or series of syllogisms.

I. Every piece of synthetic reasoning may be resolved into a syllogism or series of syllogisms, (see Logic). Thus we may reduce Cicero's argument, by which he endeavours to prove that Clodius assaulted Milo, and not Milo Clodius, to a syllogism in this manner:

He was the aggressor, whose advantage it was to kill the other.
But it was the advantage of Clodius to kill Milo, and not Milo to kill him.
Therefore Clodius was the aggressor, or he assaulted Milo.

The thing to be proved was, that Clodius assaulted Milo, which therefore comes in the conclusion: and the argument, by which it is proved, is taken from the head of profit or advantage. Thus the logician would treat this argument; and if either of the premises were questioned, he would support it with another syllogism. But this short and dry way of reasoning does not at all suit the orator: who not only for variety changes the order of the parts, beginning sometimes with the minor, and at other times with the conclusion, and ending with the major; but likewise clothes each part with such ornaments of expression as are proper to enliven the subject, and render it more agreeable and entertaining. And he frequently subjoins, either to the major proposition, or minor, and sometimes to both, one or more arguments to support them; and perhaps others to confirm or illustrate them as he thinks it requisite. Therefore, as a logical syllogism consists of three parts or propositions, a rhetorical syllogism frequently contains four, and many times five parts. And Cicero reckons this last the most complete. But all that is said in confirmation of either of the premises is accounted but as one part. This will appear more evident by examples: By a short syllogism Cicero thus proves, that the Carthaginians were not to be trusted: " Those who have often deceived us, by violating their engagements, ought not to be trusted. For if we receive any damage by their treachery, we can blame nobody but ourselves. But the Carthaginians have often so deceived us. Therefore it is madness to trust them." Here the major proposition is supported by a reason. The minor needed none; because the treachery of the Carthaginians was well known. So that this syllogism consists of four parts. But by a syllogism of five parts he proves somewhat more largely and elegantly, that the world is under the direction of a wise governor. The major is this: " Those things are better governed which are under the direction of wisdom, than those which are not." This he proves by several instances: " A house managed with prudence has every thing in better order, and more convenient, than that which is under no regulation. An army commanded by a wise and skilful general is in all respects better governed than one which has a fool or a madman at the head of it. And the like is to be said of a ship, which performs her course best under the direction of a skilful pilot." Then he proceeds to the minor thus: But nothing is better governed than the universe." Which he proves in this manner: " The rising and setting of the heavenly bodies keep a certain determined order; and the several seasons of the year do not only necessarily return in the same manner, but are suited to the advantage of the whole; nor did the vicissitudes of night and day ever yet become prejudicial, by altering their course." From all which he concludes, " that the world must be under the direction of a wise governor." In both these examples, the regular order of the parts is observed. We shall therefore produce another, in which the order is directly contrary; for beginning with the conclusion, he proceeds next to the minor proposition, and so ends with the major. In his defence of Cœlius, his design is to prove that Cœlius had not led a loose and vicious life, with which his enemies had charged him. And this he does, by showing he had closely followed his studies, and was a good orator. This may probably at first sight appear but a weak argument; though to him who considers what Cicero everywhere declares necessary to gain that character, it may perhaps be thought otherwise. The sense of what he says here may be reduced to this syllogism.

Those who have pursued the study of oratory, so as to excel in it, cannot have led a loose and vicious life.
But Cœlius has done this.
Therefore his enemies charge him wrongfully.

But let us hear Cicero himself. He begins with the conclusion, thus: " Cœlius is not chargeable with profuseness, extravagancy, contracting of debts, or intemperance, a vice which age is so far from abating, that it rather increases it. Nay, he never engaged in amours, and those pleasures of youth, as they are called, which are soon thrown off, as reason prevails." Then he proceeds to the minor, and shows from the effects, that Cœlius had closely applied himself to the best arts, by which he means those necessary for an orator: " You have now heard him make his own defence, and you formerly heard him engaged in a prosecution (I speak this to vindicate, not to applaud him), you could not but perceive his manner of speaking, his ability, his good sense, and command of language. Nor did he only discover a good genius, Disposition. genius, which will oftentimes do much of itself when it is not improved by industry; but what he said (if my affection for him did not bias my judgement) appeared to be the effect of learning, application, and study." And then he comes to the major: "But be assured, that those vices charged upon Cœlius, and the studies upon which I am now discoursing, cannot meet in the same person. For it is not possible that a mind, disturbed by such irregular passions, should be able to go through what we orators do, I do not mean only in speaking, but even in thinking." And this he proves by an argument taken from the scarcity of good orators. "Can any other reason be assigned, why so few, both now, and at all times, have engaged in this province, when the rewards of eloquence are so magnificent, and it is attended with so great delight, applause, glory, and honour? All pleasures must be neglected; diversions, recreations, and entertainments omitted; and even the conversation of all our friends must in a manner be laid aside. This it is which deters persons from the labour and study of oratory; not their want of genius or education."

33 Orators do not often use complete syllogisms, but most commonly imperfect ones, called *enthymems*.

2. By *Enthymem*. But orators do not often use complete syllogisms, but most commonly enthymems. An *enthymem*, as is shown elsewhere, is an imperfect syllogism, consisting of two parts; the conclusion, and one of the premises. And in this kind of syllogism, that proposition is omitted, whether it be the major or minor, which is sufficiently manifest of itself, and may easily be supplied by the hearers. But the proposition that is expressed is usually called the *antecedent*, and the conclusion the *consequent*. So if the major of that syllogism be omitted, by which Cicero endeavours to prove that Clodius assaulted Milo, it will make this enthymem:

The death of Milo would have been an advantage to Clodius.
Therefore Clodius was the aggressor; or, therefore, he assaulted Milo.

In like manner, that other syllogism above mentioned, by which he shows that the Carthaginians ought not to be trusted, by omitting the minor, may be reduced to the following enthymem:

Those who have often broke their faith ought not to be trusted.
For which reason the Carthaginians ought not to be trusted.

Every one would readily supply the minor, since the perfidiousness of the Carthaginians was known to a proverb. But it is reckoned a beauty in enthymems, when they consist of contrary parts, because the turn of them is most acute and pungent. Such is that of Micipsa in Sallust: "What stranger will be faithful to you who are an enemy to your friends?" And so likewise that of Cicero for Milo, speaking of Clodius: "You sit as avengers of his death; whose life you would not restore, did you think it in your power." Orators manage enthymems in the same manner they do syllogisms; that is, they invert the order of the parts, and confirm the proposition by one or more reasons; and therefore a rhetorical enthymem frequently consists of three parts, as a syllogism does of five. Though, strictly speaking, a syllogism can consist of no more than three parts, and an enthymem but of two: and the arguments brought to support either of the propositions constitute so many new enthymems, of which the part they are designed to prove is the conclusion. To illustrate this by an example:

An honest man thinks himself under the highest obligation to his country.
Therefore he should shun no danger to serve it.

In this *enthymem* the major is wanting, which would run thus: "He who is under the highest obligations to another, should shun no danger in order to serve him." This last proposition is founded upon the common principle of gratitude; which requires that, to the utmost of our power, a return should be made in proportion to the kindness received. And this being a maxim generally allowed, it is omitted by the orator. But now this enthymem, consisting of the minor and conclusion, might be managed in some such manner as this, beginning with the conclusion: "An honest man ought to shun no danger, but readily expose his life for the safety and preservation of his country." Then the reason of this conduct might be added, which is the antecedent of the enthymem, or minor of the syllogism: "For he is sensible that his obligations to his country are so many, and so great, that he can never fully requite them." And this again might be confirmed by an enumeration of particulars: "He looks upon himself as indebted to his country for every thing he enjoys; for his friends, relations, all the pleasures of life, and even for life itself. Now the orator calls this *one enthymem*, though in reality there are two: For the second reason, or argument, added to the first, becomes the antecedent of a new enthymem, of which the first reason is the consequent. And if these two enthymems were expressed separately in the natural order of the parts, the former would stand thus: "An honest man thinks himself under the highest obligations to his country; therefore he ought to shun no danger for its preservation." The latter thus: "An honest man esteems himself indebted to his country for every thing he enjoys; therefore he thinks he is under the highest obligations to it." The same thing might be proved in the like way of reasoning, by arguments of a different kind. From comparison, thus: "As it would be thought base and ungrateful in a son not to hazard himself for the preservation of his father; an honest man must certainly esteem it so when his country is in danger." Or from an example, in this manner: "An honest man in like circumstances would propose to himself the example of Decius who freely gave up his life for the service of his country. He gave up his life indeed, but did not lose it; for he cannot be said to have lost his life, who lives in immortal honour." Orators frequently intermix such arguments to adorn and illustrate their subject with others taken from the nature and circumstances of things. And now, if we consider a little this method of reasoning, we shall find it the most plain and easy imaginable. For when any proposition is laid down, and one or more reasons subjoined to prove it, each reason joined with the proposition makes a distinct enthymem, of which the proposition is the conclusion. Thus Cicero, in his seventh Philippic, lays down this as the foundation of his discourse, "That he is against a peace with Mark Antony; for which he gives three reasons: "Because it is base, because it is dangerous, and

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and becaufe it is impracticable." Thefe feverally joined with the propofition, form three enthymems; and upon each of thefe he difcourfes feparately, which make up that oration. And this method is what perfons for the moft part naturally fall into, who know nothing of the terms *fyllogifm* or *enthymem*. They advance fomething, and think of a reafon to prove it, and another perhaps to fupport that; and, fo far as their invention will affift them, or they are mafters of language, they endeavour to fet what they fay in the plaineft light, give it the beft drefs, embellifh it with proper figures and different turns of expreffion; and, as they think convenient, illuftrate it with fimilitudes, comparifons, and the like ornaments, to render it moft agreeable, till they think what they have advanced fufficiently proved. As this method of arguing therefore is the moft plain, eafy, and natural; fo it is what is moft commonly ufed in oratory. Whereas a ftrict fyllogiftical way of difcourfing is dry and jejune, cramps the mind, and does not admit of thefe embellifhments of language which are a great advantage to the orator: for which reafon he feldom ufes complete fyllogifms; and when he does, it is with great latitude. In every difcourfe care fhould be taken not to blend arguments confufedly together that are of a feparate nature. "All arguments (fays the elegant Dr Blair) are directed to prove one or other of thefe three things; that fomething is true; that it is morally right or fit; or that it is profitable and good. Thefe make the three great fubjects of difcuffion among mankind; truth, duty, and intereft. But the arguments directed towards any one of them are generally diftinct; and he who blends them all under one topic, which he calls his argument, as, in fermons efpecially, is too often done, will render his reafoning indiftinct and inelegant. Suppofe, for inftance, that I am recommending to an audience benevolence, or the love of our neighbour; and that I take my firft argument from the inward fatisfaction which a benevolent temper affords; my fecond, from the obligation which the example of Chrift lays upon us to this duty; and third, from its tendency to procure us the good will of all around us; my arguments are good, but I have arranged them wrong: for my firft and third arguments are taken from confiderations of intereft, internal peace, and external advantages; and between thefe, I have introduced one, which refts wholly upon duty. I fhould have kept thofe claffes of arguments, which are addreffed to different principles in human nature, feparate and diftinct."

34 The analytic method of reafoning nearly the fame with the Socratic.

II. The other method of reafoning is the analytic, in which the orator conceals his intention concerning the point he is to prove, till he has gradually brought his hearers to the defigned conclufion. They are led on, ftep by ftep, from one known truth to another, till the conclufion be ftolen from them, as the natural confequence of a chain of propofitions. As, for inftance, when one intending to prove the being of a God, fets out with obferving that every thing which we fee in the world has had a beginning; that whatever has had a beginning, muft have had a prior caufe; that in human productions, art fhown in the effect, neceffarily infers defign in the caufe; and proceeds leading you on from one caufe to another, till you arrive at one fupreme firft caufe, from whom is derived all the order and defign vifible in his works. This is much the fame with the Socratic method, by which that philofopher filenced the fophifts of his age.

He proceeded by feveral queftions, which being feparately granted, the thing defigned to be inferred was afterwards put, which, by reafon of its fimilitude with feveral cafes allowed before, could not be denied. But this is a captious way of reafoning; for while the refpondent is not aware of what is defigned to be inferred, he is eafily induced to make thofe conceffions, which otherwife he would not. Befides, it is not fo well fuited to continued difcourfes, as to thofe which are interlocutory; and therefore we meet with it ofteneft in the Socratic dialogues both of Plato and Xenophon. However, it may be made ufe of in oratory by a figure called *fubjection*, when the fame perfon firft puts the queftion, and then makes the anfwer. So in the famous caufe of Epaminondas, general of the Thebans, who was accufed for refufing to furrender his command to his fucceffor appointed by the ftate, till after he had engaged the enemy, and given them a total defeat, Cicero thus reprefents his accufer pleading for the words of the law againft Epaminondas, who alledged the intention of it in his defence: "Should Epaminondas add that exception to the law, which, he fays, was the intention of the writer, namely, *Except any one refufe to give up his command when it is for the intereft of the public he fhould not*; would you admit of it? I believe not. Should you yourfelves, which is a thing moft remote from your juftice and wifdom, in order to fcreen him, order this exception to be added to the law, without the command of the people; would the Thebans fuffer it to be done? No, certainly. Can it be right then to come into that, as if it was written, which it would be a crime to write? I know it cannot be agreeable to your wifdom to think fo."

35 May comprehend reafoning by example.

Under the analytic method may be comprehended reafoning by *example*. Rhetoricians ufe this word in a different fenfe from the common acceptation. For that is ufually called an *example*, which is brought either to prove or illuftrate fome general affertion: As if any one fhould fay, that *human bodies may be brought to fuftain the greateft labours by ufe and exercife*; and in order to prove this fhould relate what is faid of Milo of Croton, that "by the conftant practice of carrying a calf feveral furlongs every day, he could carry it as far after it had grown to its full fize." But in oratory the word *example* is ufed for any kind of fimilitude; or, as Voffius defines it, "When one thing is inferred from another, by reafon of the likenefs which appears between them." Hence it is called an *imperfect induction*, which infers fomething from feveral others of a like nature, and has always the greateft force when the examples are taken from facts. Now facts may be compared with refpect to fome agreement or fimilitude between them, which in themfelves are either equal or unequal. Of the former kind this is an inftance: "Cato acted as became a patriot and a lover of his country's liberty, in oppofing the arms of Cæfar: and therefore fo did Cicero." The reafon of the inference is founded in the parity of the cafe, which equally concerned all good fubjects of the Roman government at that time. For all were alike obliged to oppofe a common enemy, who endeavoured to fubvert the conftitution, and fubject them to his own arbitrary power. But though an example

Disposition. ample consists in the comparison of two single facts, yet several persons may be concerned in each fact. Of this kind is that which follows: "As Pompey, Cæsar, and Crassus, acted illegally in the first triumvirate, by engrossing the sole power into their own hands, and by that means violating the public liberty; so likewise did Augustus, Mark Antony, and Lepidus, in the second triumvirate, by pursuing the same measures." But when Cicero defends Milo for killing Clodius, from the like instances of Ahala Servilius, Scipio Nasica, Lucius Opimius, and others; that is not an example, but an induction: because one thing is there inferred from its similitude to several others. But when a comparison is made between two facts that are unequal, the inference may be either from the greater to the less, or from the less to the greater. From the greater to the less in this manner: "Cæsar had no just pretensions to the Roman government, and therefore much less had Antony." The reason lies in the difference between the two persons. Cæsar had very much enlarged the bounds of the Roman empire by his conquests, and greatly obliged the populace by his generosity; but as he had always acted by an authority from the senate and people of Rome, these things gave him no claim to a power over them. Much less then had Antony any such pretence, who always acted under Cæsar, and had never performed any signal services himself. Cicero has described the difference between them in a very beautiful manner in his second Philippic, thus speaking to Antony: "Are you in any thing to be compared to him? He had a genius, sagacity, memory, learning, care, thought, diligence; he had performed great things in war, though detrimental to the state; he had for many years designed to get the government into his hands, and obtained his end by much labour and many dangers; he gained over the ignorant multitude by public shows, buildings, congiaries, and feasts; obliged his friends by rewards, and his enemies by a show of clemency. In a word, he subjected a free state to slavery, partly through fear, and partly compliance. I can liken you to him for ambition of power; but in other things you are in no respect to be compared with him." By a comparison from the less to the greater, Cicero thus argues against Catiline: "Did the brave Scipio, when a private man, kill Tiberius Gracchus, for attempting to weaken the state; and shall we consuls bear with Catiline endeavouring to destroy the world by fire and sword?" The circumstances of these two cases were very different; and the comparison runs between a private man and a consul intrusted with the highest authority; between a design only to raise a tumult, and a plot to destroy the government: whence the orator justly infers, that what was esteemed lawful in one case, was much more so in the other. The like way of reasoning is sometimes used from other similitudes, which may be taken from things of all kinds, whether animate or inanimate. Of the former sort is that of Cicero speaking of Muræna, when candidate for the consulship, after he had himself gone through that office: "If it is usual (says he) for such persons as are safely arrived in port, to give those who are going out the best account they can with relation to the weather, pirates, and coasts; because thus nature directs us to assist those who are entering upon the same dangers which we ourselves have escaped: how ought I, who now after a great storm am brought within a near prospect of land, to be affected towards him, who, I perceive, must be exposed to the greatest tempests of the state?" He alludes to the late disturbances and tumults occasioned by the conspiracy of Catiline, which had been so happily suppressed by him in the time of his consulate. Of the latter kind is that of Quintilian: "As the ground is made better and more fruitful by culture, so is the mind by instruction." There is both a beauty and justness in this simile.

Disposition. But comparisons are sometimes made between facts and other things, in order to infer some difference or opposition between them. In comparing two facts, on account of some disagreement and unlikeness, the inference is made from the difference between one and the other in that particular respect only. As thus: "Though it was not esteemed cruelty in Brutus to put his two sons to death, for endeavouring to betray their country; it might be so in Manlius, who put his son to death, only for engaging the enemy without orders, though he gained the victory." The difference between the two facts lies in the different nature of the crime. The sons of Brutus entered into a conspiracy to betray their country; and though they miscarried in it, yet the intention and endeavours they used to accomplish it were criminal in the highest degree. But young Manlius could only be charged with rashness. His design was honourable, and intended for the interest of his country; only it was irregular, and might have proved of ill consequence to military discipline. Now in all such cases, the force of the argument is the stronger the greater the difference appears. But the same facts which differ in one respect may agree in many others; as in the example here mentioned. Brutus and Manlius were both magistrates as well as fathers; they both killed their sons, and that for a capital crime by the Roman law. In any of which respects they may be compared in a way of similitude: as, "If Brutus might lawfully put his son to death for a capital crime, so might Manlius." But now contrary facts do not only differ in some certain respect, but are wholly opposite to each other; so that what is affirmed of the one must be denied of the other; and if one be a virtue, the other is a vice. Thus Cicero compares the conduct of Marcellus and Verres in a way of opposition. "Marcellus (says he), who had engaged, if he took Syracuse, to erect two temples at Rome, would not beautify them with the spoils he had taken: Verres, who had made no vows to Honour and Virtue, but to Venus and Cupid, endeavoured to plunder the temple of Minerva. The former would not adorn the gods with the spoils of other deities: the latter carried the ornaments of Minerva, a virgin, into the house of a strumpet." If therefore the conduct of Marcellus was laudable and virtuous, that of Verres must bear the contrary character. But this way of reasoning has likewise place in other respects. Thus Cicero, in the quarrel between Cæsar and Pompey, advised to peace from the difference between a foreign and domestic war: "That the former might prove beneficial to the state; but in the latter, whichever side conquered, the public must suffer." And thus the ill effects of intemperance may be shown in a way of opposition: "That as temperance preserves the health of the body, keeps up the vigour of the mind, and prolongs life; so excess must necessarily have the contrary effects.

Thus we have given a brief account of the principal ways

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ways of reafoning commonly made ufe of by orators. As to the difpofition of arguments, or the order of placing them, fome advife to put the weaker, which cannot wholly be omitted, in the middle: and fuch as are ftronger, partly in the beginning, to gain the efteem of the hearers, and render them more attentive; and partly at the end, becaufe what is laft heard is likely to be retained longeft: But if there are but two arguments, to place the ftronger firft, and then the weaker; and after that to return again to the former, and infift principally upon that. But this muft be left to the prudence of the fpeaker, and the nature of the fubject. Though to begin with the ftrongeft, and fo gradually defcend to the weakeft, can never be proper, for the reafon laft mentioned. Nor ought arguments to be crowded too clofe upon one another; for that takes off from their force, as it breaks in upon the attention of the hearers, and does not leave them fufficient time duly to confider them. Nor indeed fhould more be ufed than are neceffary; becaufe the fewer they are, the more eafily they are remembered. And the obfervation of a great mafter of eloquence upon this fubject is certainly very juft, that *arguments ought rather to be weighed than numbered.*

CHAP. V. *Of Confutation.*

36 Forms of confutation the fame with thofe of confirmation, but more difficult.

THE forms of reafoning here are the fame as have been already explained under *confirmation. Confutation*, however, is often the more difficult tafk; becaufe he who is to prove a thing comes ufually prepared: but he who is to confute it is frequently left to a fudden anfwer. For which reafon, in *judicial* cafes, Quintilian fays, "It is as much eafier to accufe than defend, as it is to make a wound than to heal it." Therefore, not only a good judgement, but a readinefs of thought alfo, feems neceffary for this province. But, in all difputes, it is of the greateft confequence to obferve where the ftrefs of the controverfy lies. For without attending to this, perfons may cavil about different matters, without underftanding each other, or deciding any thing. And in confutation, what the adverfary has advanced ought carefully to be confidered, and in what manner he has expreffed himfelf. As to the things themfelves, whether they immediately relate to the matter in difpute, or are foreign to it. Thofe things that are foreign to the fubject may either be paft over in filence, or in a very few words fhown to be infignificant. And there ought likewife to be a diftinction made between fuch things as relate to the fubject, according to their importance. Thofe that appear to have no great weight fhould be flightly remarked. For to infift largely upon fuch matters is both tirefome to the hearers, and apt to bring the judgement of the fpeaker in queftion. And therefore things of that nature are generally better turned off with an air of neglect, a pungent queftion, or an agreeable jeft, than confuted by a ferious and laboured anfwer. But thofe things, which relate to the merits of the caufe, may be confuted either by *contradicting* them, or by fhowing fome *miftake* in the reafoning, or their *invalidity* when granted.

Things may be *contradicted* feveral ways. What is apparently falfe may be exprefsly *denied.* Thus Cicero in his defence of Cluentius: "When the accufer had faid, that the man fell down dead after he had drunk off his cup, denies that he died that day." And things which the adverfary cannot prove, may likewife be denied. Of which we have alfo an inftance in Cicero, who firft upbraids Mark Antony as guilty of a breach not only of good breeding, but likewife of friendfhip, for reading publicly a private letter he had fent him. And then adds, "But what will you fay now, if I fhould deny that ever I fent you that letter? How will you prove it? By the hand-writing? In which I confefs you have a peculiar fkill, and have found the benefit of it. But how can you make it out? For it is in my fecretary's hand. I cannot but envy your mafter who had fo great a reward for teaching you to underftand juft nothing. For what can be more unbecoming not only an orator, but even a man, than for any one to offer fuch things, which if the adverfary denies he has nothing more to fay?" It is an handfome way of contradicting a thing, by fhowing that the adverfary himfelf maintained the contrary. So when Oppius was charged with defrauding the foldiers of their provifions, Cicero refutes it, by proving, that the fame perfons charged Oppius with a defign to corrupt the army by his liberality. An adverfary is never more effectually filenced than when you can faften contradictions upon him; for this is ftabbing him with his own weapon. Sometimes a thing is not in exprefs terms denied, but reprefented to be utterly incredible. And this method expofes the adverfary more than a bare denial. So when fome perfons reproached Cicero with cowardice, and a fhameful fear of death, he recites their reafons in fuch a manner, that any one would be inclined to think the charge entirely falfe. "Was it becoming me (fays he) to expect death with that compofednefs of mind as fome have imagined? Well, and did I then avoid it? Nay, was there any thing in the world that I could apprehend more defirable? Or, when I had done the greateft things in fuch a crowd of ill-minded perfons about me, do you think banifhment and death were not always in my view, and continually founding in my ears as my certain fate, while I was fo employed? Was life defireable when all my friends were in fuch forrow, and myfelf in fo great diftrefs, deprived of all the gifts both of nature and fortune? Was I fo unexperienced, fo ignorant, fo void of reafon and prudence? Had I never feen or heard any thing in my whole life? Did all I had read and ftudied avail nothing? What! did not I know that life is fhort, but the glory of generous actions permanent? When death is appointed for all, does it not feem eligible, that life, which muft be wrefted from us, fhould rather be freely devoted to the fervice of our country, than referved to be worn out by the decays of nature? Was not I fenfible, there has been this controverfy among the wifeft men, that fome fay, the minds of men and their confciences utterly perifh at death; and others, that the minds of wife and brave men are then in their greateft ftrength and vigour, when they are fet free from the body? The firft ftate is not greatly to be dreaded, to be void of fenfe: but the other, of enjoying larger capacities, is greatly to be defired. Therefore, fince I always aimed at dignity, and thought nothing was worth living for without it; how fhould I, who am paft the confulfhip, and did fo great things in it, be afraid to die?" Thus far Cicero. There is likewife an ironical way of contradicting a thing, by retorting that and other things of the like nature upon the

Difpofition. the adverfe party: Thus Cicero, in his oration againft Vatinius, fays: "You have objected to me, that I defended Cornelius, my old friend, and your acquaintance. But pray why fhould I not have defended him? Has Cornelius carried any law contrary to the omens? Has he violated any law? Has he affaulted the conful? Did he take poffeffion of a temple by force of arms? Did he drive away the tribune, who oppofed the paffing a law? Has he thrown contempt upon religion? Has he plundered the treafury? Has he pillaged the ftate? No, thefe, all thefe, are your doings." Such an unexpected return is fometimes of great fervice to abate the confidence of an adverfary.

A fecond way of confutation is, by obferving fome *flaw* in the reafoning of the adverfe party. We fhall endeavour to illuftrate this from the feveral kinds of reafoning treated of before under *confirmation*. And firft, as to fyllogifms; they may be refuted, either by fhowing fome miftake in the premifes, or that the conclufion is not juftly deduced from them. So when the Clodian party contended, that Milo ought to fuffer death for this reafon, Becaufe he had confeffed that he had killed Clodius; that argument, reduced to a fyllogifm, would ftand thus:

He who confeffes he has killed another, ought not to be allowed to fee the light.
But Milo confeffes this.
Therefore he ought not to live.

Now the force of this argument lies in the major or firft propofition; which Cicero refutes, by proving, that the Roman people had already determined contrary to what is there afferted: "In what city (fays he) do thefe men difpute after this weak manner? In that wherein the firft capital trial was in the cafe of the brave Horatius, who, before the city enjoyed perfect freedom, was faved by the fuffrages of the Roman people, though he confeffed that he killed his fifter with his own hand." But when Cicero accufed Verres for maladminiftration in his government of Sicily, Hortenfius, who defended him, being fenfible the allegations brought againft him could not be denied, had no other way left to bring him off, but by pleading his military virtues in abatement, which at that time were much wanted, and very ferviceable to the ftate. The form of the argument was this:

That the Romans then wanted good generals.
That Verres was fuch.
And confequently, that it was for the intereft of the public that he fhould not be condemned.

But Cicero, who knew his defign, ftates the argument for him in his charge; and then anfwers it by denying the confequeuce, fince the crimes of Verres were of fo heinous a nature, that he ought by no means to be pardoned on the account of any other qualifications: Though indeed he afterwards refutes the minor or fecond propofition, and fhows that he had not merited the character of a good general. Enthymems may be refuted, either by fhowing that the antecedent is falfe, or the confequent not juftly inferred from it. As thus, with refpect to the former cafe:

A ftrict adherence to virtue has often proved detrimental. Difpofition.
Therefore virtue ought not conftantly to be embraced.

Here the antecedent may be denied. For virtue is alway beneficial to thofe who ftrictly adhere to it, both in the prefent fatisfaction it affords them, and the future rewards they may certainly expect from it. And as to the latter cafe, in this manner:

She is a mother.
Therefore fhe loves her children.

Now as the certainty of that inference depends upon this general affertion, That all mothers love their children, which is not true, the miftake of the reafoning may be fhown from the inftance of Medea and others, who deftroyed their own children. As to *induction* and *example*, by which the truth or equity of a thing is proved from its likenefs to one or more other things; the reafoning in either is invalid, if the things fo compared can be fhown not to have that fimilitude or agreement on which the inference is founded. One inftance therefore may ferve for both. As when Cicero, after the death of Cæfar, pleaded for the continuance of his laws, but not of thofe which were made afterwards by Mark Antony: Becaufe, though both were in themfelves invalid, and impofitions upon the public liberty; yet fome of Cæfar's were ufeful, and others could not be fet afide without difturbance to the ftate, and injuring particular perfons; but thofe of Antony were all detrimental to the public.

The laft method of *confutation* before-mentioned was, when the orator does in fome fenfe *grant* the adverfary his argument, and at the fame time fhows its *invalidity*. And this is done by a variety of ways, according to the different nature of the fubject. Sometimes he allows what was faid may be true; but pleads, that what he contends for is neceffary. This was the method by which Hortenfius propofed to bring off Verres, as we have already fhown from Cicero, whofe words are thefe, addreffing himfelf to the judges; "What fhall I do? which way fhall I bring in my accufation? where fhall I turn myfelf? for the character of a brave general is placed like a wall againft all the attacks I can make. I know the place, I perceive where Hortenfius intends to difplay himfelf. He will recount the hazards of war, the neceffities of the ftate, the fcarcity of commanders; and then he will entreat you, and do his utmoft to perfuade you not to fuffer the Roman people to be deprived of fuch a commander upon the teftimony of the Sicilians, nor the glory of his arms to be fullied by a charge of avarice." At other times the orator pleads, that although the contrary opinion may feem to be attended with advantage, yet that his own is more juft, or honourable. Such was the cafe of Regulus, when his friends endeavoured to prevail with him to continue at Rome, and not return to Carthage, where he knew he muft undergo a cruel death. But as this could not be done without violating his oath, he refufed to hearken to their perfuafions. Another way of confutation is, by retorting upon the adverfary his own argument. Thus Cicero, in his defence of Ligarius, fays: "You have, Tubero, that which is moft defirable to an accufer, the confeffion of the accufed party; but yet fuch a confeffion,

Diſpoſition.

confeſſion, that he was on the ſame ſide that you, Tubero, choſe yourſelf, and your father too, a man worthy of the higheſt praiſe. Wherefore, if there was any crime in this, you ought firſt to confeſs your own before you attempt to faſten any upon Ligarius." The orator takes this advantage where an argument proves too much, that is, more than the perſon deſigned it for, who made uſe of it. Not much unlike this is what they call *inverſion*, by which the orator ſhows, that the reaſons offered by the oppoſite party make for him. So when Cæcilius urged, that the province of accuſing Verres ought to be granted to him, and not to Cicero, becauſe he had been his treaſurer in Sicily at the time thoſe crimes were committed with which he was charged, and conſequently knew moſt of that affair; Cicero turns the argument upon him, and ſhows, for that very reaſon he was the moſt unfit of any man to be intruſted with his proſecution; ſince having been concerned with him in his crimes, he would certainly do all in his power to conceal or leſſen them. Again, ſometimes the charge is acknowledged, but the crime ſhifted off to another. Thus, when Sextius was accuſed of ſedition, becauſe he had got together a body of gladiators, and brought them into the forum, where a warm engagement happened between them and Clodius's faction; Cicero owns the fact, but charges the crime of ſedition upon Clodius's party in being the aggreſſors. Another method made uſe of for the ſame purpoſe is to alleviate the charge, and take off the force of it, by ſhowing, that the thing was not done with that intention which the adverſary inſinuates. Thus Cicero, in his defence of King Dejotarus, owns he had raiſed ſome forces, though not to invade the Roman territories, as had been alledged, but only to defend his own borders, and ſend aid to the Roman generals.

We have hitherto been ſpeaking of the methods of confutation uſed by orators, in anſwering thoſe arguments which are brought by the contrary party. But ſometimes they raiſe ſuch objections themſelves to what they have ſaid, as they imagine may be made by others; which they afterwards anſwer, the better to induce their hearers to think that nothing conſiderable can be offered againſt what they have advanced, but what will admit of an eaſy reply. Thus, when Cicero, at the requeſt of the Sicilians, had undertaken the accuſation of Verres, it came under debate, whether he, or Cæcilius, who had been Verres's quæſtor in Sicily, ſhould be admitted to that province. Cicero, therefore, in order to ſet him aſide, among other arguments, ſhows his incapacity for ſuch an undertaking, and for that end recounts at large the qualifications neceſſary for an orator. Which he repreſents to be ſo many and great, that he thought it neceſſary to ſtart the following objection to what he had himſelf ſaid upon that ſubject. "But you will ſay perhaps, Have you all theſe qualifications?" To which he thus replies: "I wiſh I had; but it has been my conſtant ſtudy from my youth to gain them. And if, from their greatneſs and difficulty, I have not been able to attain them, who have done nothing elſe through my whole life; how far, do you imagine, you muſt be from it, who never thought of them before; and even now, when you are entering upon them, have no apprehenſion what, and how great, they are?" This is an effectual way of defeating an adverſary, when the objection is well founded, and clearly anſwered. But we ſhall have occaſion to conſider this matter more largely hereafter, under the figure *prolepſis*, to which it properly relates.

Chap. VI. *Of the Concluſion.*

37 The concluſion is a recapitulation and addreſs to the paſſions.

Rhetoricians make the *concluſion* of a diſcourſe to conſiſt of two parts: *recapitulation*, and *an addreſs to the paſſions*.

1. *Recapitulation* is a ſummary account of what the ſpeaker has before offered in maintenance of his ſubject; and is deſigned both to refreſh the memory of the hearers, and to bring the principal arguments together into a narrow compaſs, that they may appear in a ſtronger light. Now there are ſeveral things neceſſary to a good repetition.

And firſt, it muſt be ſhort and conciſe; ſince it is deſigned to refreſh the memory, and not to burden it. For this end, therefore, the chief things only are to be touched upon; thoſe on which the cauſe principally depends, and which the orator is moſt deſirous ſhould be regarded by his hearers. Now theſe are, The general heads of the diſcourſe, with the main arguments brought to ſupport them. But either to inſiſt particularly upon every minute circumſtance, or to enlarge upon thoſe heads which it may be thought proper to mention, carries in it not ſo much the appearance of a repetition, as of a new diſcourſe.

Again, it is convenient in a repetition to recite things in the ſame order in which they were at firſt laid down. By this means the hearers will be enabled much better to keep pace with the ſpeaker as he goes along; and if they happen to have forgot any thing, they will the more readily recal it. And beſides, this method appears moſt ſimple and open, when the ſpeaker reviews what he has ſaid in the ſame manner it was before delivered, and ſets it in the cleareſt light for others to judge of it. But though a repetition contains only the ſame things which had been more largely treated of before; yet it is not neceſſary they ſhould be expreſſed in the ſame words. Nay, this would many times be tireſome and unpleaſant to the hearers; whereas a variety of expreſſion is grateful, provided the ſenſe be the ſame. Beſides, every thing ought now to be repreſented in the ſtrongeſt terms, and in ſo lively a manner, as may at the ſame time both entertain the audience, and make the deepeſt impreſſion upon their minds. We have a very exact and accurate example of repetition in Cicero's oration for Quintius. Cicero was then a young man, and ſeems to have kept more cloſely to the rules of art, than afterwards, when, by uſe and practice, he had gained a greater freedom of ſpeaking. We formerly cited the partition of this ſpeech, upon another occaſion, which runs thus: "We deny, Sextus Nevius, that you were put into the poſſeſſion of the eſtate of P. Quintius, by the prætor's edict. This is the diſpute between us. I will therefore ſhow, firſt, that you had no juſt cauſe to apply to the prætor for the poſſeſſion of the eſtate of P. Quintius; then that you could not poſſeſs it by the edict; and laſtly, that you did not poſſeſs it. When I have proved theſe three things, I will conclude," Now Cicero begins his concluſion with a repetition of thoſe three heads, and a ſummary account of the ſeveral arguments he made uſe of under each of them. But they are too long to be here exhibited. In his

Disposition. his oration for the Manilian law, his repetition is very short. He proposed in the partition to speak to three things: The nature of the war against King Mithridates, the greatness of it, and what sort of general was proper to be intrusted with it. And when he has gone through each of these heads, and treated upon them very largely, he reduces the substance of what he has said to this general and short account: "Since therefore the war is so necessary, that it cannot be neglected; and so great, that it requires a very careful management; and you can intrust it with a general of admirable skill in military affairs, of singular courage, the greatest authority, and eminent success: do you doubt to make use of this so great a blessing, conferred and bestowed upon you by heaven, for the preservation and enlargement of the Roman state?" Indeed this repetition is made by Cicero, before he proceeds to the confutation; and not at the end of his discourse, where it is usually longer and more particular: however, this may serve to show the nature of such a recital.

But sometimes a repetition is made, by running a comparison between the speaker's own arguments and those of the adverse party; and placing them in opposition to each other. And this method Cicero takes in the conclusion of his third oration upon the Agrarian law. And here sometimes the orator takes occasion to find fault with his adversary's management, in these and such like expressions: "This part he has entirely dropt. To that he has given an invidious turn, or a false colouring. He leaves arguments, and flies to intreaties; and not without good reason, if we consider the weakness of his cause."

But when the discourse is very long, and the arguments insisted on have been many, to prevent the hearers growing out of patience by a more particular recital, the orator sometimes only just mentions such things, which he thinks of least consequence, by saying, that he omits or passes over them, till he comes to what is of greater moment, which he represents more fully. This method Cicero has taken in his defence of Cluentius; where, having run over several lesser heads in the manner now described, he then alters his expression, and introduces what was of more importance, by saying, "What I first complain of, is that wickedness, which is now discovered." And so he proceeds more particularly to recite those things which immediately related to Cluentius. And this is what the writers upon this art call *preterition*. But this much may serve for repetition or recapitulation.

2. We now proceed to the other part of the conclusion, which consists in an *address to the passions*. Indeed the orator sometimes endeavours occasionally to work upon the passions of his hearers in other parts of his discourse, but more especially in the conclusion, where he is warmest himself, and labours to make them so. For the main design of the introduction is to conciliate the hearers, and gain their attention; of the narration, proposition, and confirmation, to inform them; and of the conclusion, to move them. And therefore, to use Quintilian's words, "Here all the springs of eloquence are to be opened. It is here we secure the minds of the hearers, if what went before was well managed. Now we are past the rocks and shallows, all the sails may be hoisted. And as the greatest part of the conclusion consists in illustration, the most pompous language and strongest figures have place here." Now the passions, to which the orator more particularly addresses, differ according to the nature of the discourse. In demonstrative orations, when laudatory,—love, admiration, and emulation, are usually excited; but in invectives,—hatred, envy, and contempt. In deliberative subjects, either the hope of gratifying some desire is set in view, or the fear of some impending evil. And in judicial discourses, almost all the passions have place, but more especially resentment and pity; insomuch that most of the ancient rhetoricians mention only these two. But having treated upon the nature of the passions, and the methods suited both to excite and allay them, in a former chapter, we shall at present only add a few general observations, which may not be improper in this place, where the skill of the orator in addressing to them is more especially required.

The orator will observe what circumstances either of things, or persons, or both, will furnish him with motives proper to apply to those passions he desires to excite in the minds of his hearers. Thus Cicero, in his orations for Plancus and Sylla, moves his hearers from the circumstances of the men; but in his accusation of Verres, very frequently from the barbarity and horrid nature of his crimes; and from both, in his defence of Quintius.

But the same passion may be excited by very different methods. This is plain from the writings of those Roman satirists which are yet extant; for they have all the same design, and that is to engage men to a love of virtue, and hatred of vice: but their manner is very different, suited to the genius of each writer. Horace endeavours to recommend virtue, by laughing vice out of countenance; Persius moves us to an abhorrence and detestation of vice, with the gravity and severity of a philosopher; and Juvenal, by open and vehement invectives. So orators make use of all these methods in exciting the passions; as may be seen by their discourses, and particularly those of Cicero. But it is not convenient to dwell long upon the same passion. For the image thus wrought up in the minds of the hearers does not last a great while; but they soon return to reflection. When the emotion, therefore, is once carried as high as it well can be, they should be left under its influence, and the speaker proceed to some new matter, before it declines again.

Moreover, orators sometimes endeavour to raise contrary passions to each other, as they are concerned for opposite parties. So the accuser excites anger and resentment, but the defendant pity and compassion. At other times, one thinks it sufficient to allay and take off that passion which the other has raised, and bring the hearers to a calm and sedate consideration of the matter before them.

But this especially is to be regarded, that the orator express the same passion himself with which he endeavours to affect others; and that not only in his action and voice, but likewise in his language: and therefore his words, and manner of expression, should be suited to that perturbation and disorder of mind which he designs to represent. However, a decency and propriety of character is always carefully to be observed; for, as Cicero very well remarks, "A neglect of this is not only very culpable in life, but like-

Diſpoſition. wiſe in diſcourſe. Nor do the ſame things equally become every ſpeaker, or every audience; nor every time, and every place." And therefore he greatly commends that painter, who, deſigning to repreſent in a picture the ſacrifice of Iphigenia, Agamemnon's daughter, drew Calchas the prieſt with a ſad countenance; Ulyſſes, her father's great friend, more dejected; and her uncle Menelaus, moſt diſconſolate; but threw a veil over the face of Agamemnon himſelf, as being unable to expreſs that exceſs of ſorrow which he thought was proper to appear in his countenance. And this juſtneſs of character is admirably well obſerved by Cicero himſelf, in his defence of Milo; for as Milo was always known to be a man of the greateſt reſolution, and moſt undaunted courage, it was very improper to introduce him (as the uſual method then was in capital caſes) moving pity, and begging for mercy. Cicero therefore takes this part upon himſelf; and what he could not do with any propriety in the perſon of Milo, he performs in his own, and thus addreſſes the judges: "What remains, but that I intreat and beſeech you, that you would ſhow that compaſſion to this brave man, for which he himſelf does not ſolicit, but I, againſt his inclination, earneſtly implore and requeſt. Do not be leſs inclined to acquit him, if in this our common ſorrow, you ſee no tear fall from Milo's eyes; but perceive in him the ſame countenance, voice, and language, as at other times, ſteady and unmoved. Nay, I know not whether for this reaſon, you ought not much ſooner to favour him: For if, in the conteſts of gladiators (perſons of the loweſt condition and fortune in life), we are wont to be diſpleaſed with the timorous aud ſuppliant, and thoſe who beg for their life; but interpoſe in favour of the brave and courageous, and ſuch as expoſe themſelves to death; and we ſhow more compaſſion to thoſe who do not ſue for it, than to thoſe who do: with how much greater reaſon ought we to act in the ſame manner towards the braveſt of our fellow citizens?" And as theſe words were agreeable to his own character, while ſoliciting in behalf of another; ſo, immediately after, he introduces Milo ſpeaking like himſelf, with a generous and undaunted air: "Theſe words of Milo (ſays he) quite ſink and diſpirit me, which I daily hear from him. Farewell, farewell, my fellow citizens, farewell! may you be happy, flouriſh, and proſper; may this renowned city be preſerved, my moſt dear country, however it has treated me; may it continue in peace, though I cannot continue in it, to whom it owes its peace. I will retire, I will be gone."

But as perſons are commonly more affected with what they ſee than with what they hear, orators ſometimes call in the aſſiſtance of that ſenſe in moving the paſſions. For this reaſon it was uſual among the Romans, in judicial caſes, for accuſed perſons to appear with a dejected air and a ſordid garb, attended by their parents, children, or other relations and friends, with the like dreſs and aſpect; as likewiſe to ſhow their ſcars, wounds, bloody garments, and other things of the like nature, in open court. So when, upon the death of Cæſar, Mark Antony harangued the populace, he at the ſame time expoſed to their view the garment in which he was ſtabbed, fixed upon a pole; at which ſight they were ſo enraged, that immediately they ran with lighted torches to ſet fire to the houſes of the conſpirators. But this cuſtom at laſt became ſo common, and was ſometimes ſo ill conducted, that the force of it was greatly abated, as we learn from Quintilian. However, if the Romans proceeded to an exceſs on the one hand, the ſtrictneſs of the Areopagites at Athens may perhaps be thought too rigid on the other; for in that court, if the orator began to ſay any thing which was moving, an officer immediately ſtood up and bade him be ſilent. There is certainly a medium between theſe two extremes, which is ſometimes not only uſeful, but even neceſſary; for, as Quintilian very juſtly ſays, "It is neceſſary to apply to the paſſions, when thoſe things which are true, juſt, and of common benefit, cannot be come at any other way." Diſpoſition.

Chap. VII. *Of Digreſſion, Tranſition, and Amplification.*

38 Digreſſion, tranſition, and amplification, defined and explained.

The number, order, and nature of the parts which conſtitute a complete and regular oration, we have endeavoured to explain in ſeveral preceding chapters. But there are two or three things yet remaining, very neceſſary to be known by an orator, which ſeem moſt properly to come under the ſecond branch of his art. And theſe are, *Digreſſion*, *Tranſition*, and *Amplification*.

I. *Digreſſion*, as defined by Quintilian, is, "A going off from the ſubject we are upon to ſome different thing, which may however be of ſervice to it." We have a very beautiful inſtance of this in Cicero's defence of Cœlius, who was accuſed of having firſt borrowed money of Clodia, and then engaging her ſervants to poiſon her. Now, as the proof of the fact depended upon ſeveral circumſtances, the orator examines them ſeparately; and ſhows them to be all highly improbable. "How (ſays he) was the deſign of this poiſon laid? Whence came it? how did they get it? by whoſe aſſiſtance, to whom, or where, was it delivered?" Now to the firſt of theſe queries he makes the accuſer give this anſwer: "They ſay Cœlius had it at home, and tried the force of it upon a ſlave provided on purpoſe, whoſe ſudden death proved the ſtrength of the poiſon." Now as Cicero repreſents the whole charge againſt Cœlius as a fiction of Clodia, invented out of revenge for ſome ſlights he had put upon her; to make this the more probable, he inſinuates that ſhe had poiſoned her huſband, and takes this opportunity to hint it, that he might ſhow how eaſy it was for her to charge another with poiſoning a ſervant, who had done the ſame to her own huſband. But not contented with this, he ſteps out of his way, and introduces ſome of the laſt words of her huſband Metellus, to render the fact more barbarous and ſhocking, from the admirable character of the man. "O immortal gods! why do you ſometimes wink at the greateſt crimes of mankind, or delay the puniſhment of them to futurity! For I ſaw, I myſelf ſaw (and it was the moſt doleful ſcene of my whole life) when Q. Metellus was taken from the boſom of his country; and when he, who thought himſelf born to be ſerviceable to this ſtate, within three days after he had appeared with ſuch advantage in the ſenate, in the forum, and everywhere in public, was ſnatched from us in the flower of his age, and prime of his ſtrength and vigour. At which time, when

Disposition. when he was about to expire, and his mind had lost the sense of other things, still retaining a concern for the public, he looked upon me, as I was all in tears, and intimated in broken and dying words, how great a storm hung over the city and threatened the whole state; often striking the wall which separated his house from that of Quintus Catulus, and frequently calling both upon him and me, and seeming to grieve not so much at the approach of his own death, as that both his country and I should be deprived of his assistance. Had he not been wickedly taken off on a sudden, how would he after his consulship have withstood the fury of his kinsman Publius Clodius, who, while in that office, threatened, in the hearing of the senate, to kill him with his own hand, when he first began to break out? And will this woman dare to come out of those doors, and talk of the force of poison? will not she fear, lest the house itself should speak the villany? will not she dread the conscious walls, nor that sad and mournful night? But I return to the accusation." And then he proceeds to consider and refute the several circumstances of the accusation. All this was no part of his argument; but having mentioned the charge of poison, he immediately takes occasion to introduce it, in order to excite the indignation of the hearers against Clodia, and invalidate the prosecution as coming from a person of her character. Digression cannot properly be said to be a necessary part of a discourse; but it may sometimes be very convenient, and that upon several accounts.

As first, when a subject is of itself flat and dry, or requires close attention, it is of use to relieve and unbend the mind by something agreeable and entertaining. For which reason Quintilian observes, that the orators of his time generally made an excursion in their harangues upon some pleasing topic, between the narration and the proof. But he condemns the practice as too general; for while they seemed to think it necessary, it obliged them sometimes to bring in things trifling and foreign to the purpose. Besides, a digression is confined to no one part of a discourse, but may come in anywhere, as occasion offers; provided it fall in naturally with the subject, and be made some way subservient to it. We never meet with it in Cicero, without some evident and good reason. So in his prosecution of Verres for his barbarous and inhuman outrages against the Sicilians, he takes an occasion to launch out in a beautiful description of the island, and to recount the advantages which accrued from it to the Romans. His subject did not necessarily lead him to this, but his view in it was to heighten and aggravate the charge against Verres.

Again, as a *digression* ought not to be made without sufficient reason, so neither should it be too frequent. And he who never does it but where it is proper and useful, will not often see occasion for it. Frequently to leave the subject, and go off to other things, breaks the thread of the discourse, and is apt to introduce confusion. Indeed some kinds of writing admit of a more frequent use of digressions than others. In history they are often very serviceable. For as that consists of a series of facts, and a long continued narrative without variety is apt to grow dull and tedious; it is necessary at proper distances to throw in something entertaining, in order to enliven it, and keep up the attention. And accordingly we find the best historians often embellish their writings with descriptions of cities, rivers, and countries, as likewise with the speeches of eminent persons upon important occasions, and other ornaments, to render them the more pleasing and delightful. Poets take a still greater liberty in this respect; for as their principal view is most commonly to please, they do not attend so closely to connection; but as an image offers itself, which may be agreeably wrought up, they bring it in, and go off more frequently to different things, than other writers.

Another property of a *digression* is, that it ought not to be too long, lest the hearers forget what preceded, before the speaker returns again to his subject.

For a digression being no principal part of a discourse, nor of any further use than as it serves some way or other to enforce or illustrate the main subject; it cannot answer this end, if it be carried to such a length, as to cause that either to be forgotten or neglected. And every one's memory will not serve him to connect together two parts of a discourse, which lie at a wide distance from each other. The better therefore to guard against this, it is not unusual with orators, before they enter upon a digression of any considerable length, to prepare their hearers by giving them notice of it, and sometimes desiring leave to divert a little from the subject. And so likewise at the conclusion they introduce the subject again by a short transition. Thus Cicero in the example cited above, when he has finished his digression concerning the death of Metellus, proceeds to his subject again with these words: "But I return to the accusation."

Indeed we find orators sometimes, when sore pressed, and the cause will not bear a close scrutiny, artfully run into digressions with a design to divert the attention of the hearers from the subject, and turn them to a different view. And in such cases, as they endeavour to be unobserved, so they do it tacitly without any transition or intimation of their design; their business being only to get clear of a difficulty, till they have an opportunity of entering upon some fresh topic.

39 Transitions often used on various occasions.

II. *Transitions* are often used not only after a digression, but likewise upon other occasions. A transition is, "A form of speech, by which the speaker in a few words tells his hearers both what he has said already, and what he next designs to say." Where a discourse consists of several parts, this is often very proper in passing from one to another, especially when the parts are of a considerable length; for it assists the hearers to carry on the series of the discourse in their mind, which is a great advantage to the memory. It is likewise a great relief to the attention, to be told when an argument is finished, and what is to be expected next. And therefore we meet with it very frequently in history. But we consider it at present only as made use of by orators. Cicero, in his second oration against Catiline, who had then left Rome, having at large described his conduct and designs, he adds: "But why do I talk so long concerning one enemy, and such an one; who owns himself an enemy, and whom I do not fear, since, what I always desired, there is now a wall between us; and say nothing of thoſe, who conceal themſelves, who remain at Rome, and among us?" And then he proceeds to give an account of the other conſpirators.

But ſometimes, in paſſing from one thing to another, a general hint of it is thought ſufficient to prepare the hearers, without particularly ſpecifying what has been ſaid, or is next to follow. Thus Cicero in his ſecond Philippic ſays, "But thoſe things are old, this is yet freſh." And again: "But I have inſiſted too long upon trifles; let us come to things of greater moment." And at other times, for greater brevity, the tranſition is imperfect, and mention made only of the following head, without any intimation of what has been ſaid already. As in Cicero's defence of Muræna, where he ſays: "I muſt now proceed to the third part of my oration concerning the charge of bribery." And ſoon after: I come now to Cato, who is the ſupport and ſtrength of this charge."

40 Amplification defined and explained.

III. The third and laſt head is, *Amplification*. Now by amplification is meant, not barely a method of enlarging upon a thing: but ſo to repreſent it in the fulleſt and moſt comprehenſive view, as that it may in the livelieſt manner ſtrike the mind and influence the paſſions. Cicero, ſpeaking of this, calls it *the greateſt commendation of eloquence;* and obſerves, "that it conſiſts not only in magnifying and heightening a thing, but likewiſe in extenuating and leſſening it." But though it conſiſts of theſe two parts, and may be applied either way; yet to amplify, is not to ſet things in a falſe light, but to paint them in their juſt proportion and proper colours, ſuitable to their nature and qualities. Rhetoricians have obſerved ſeveral ways of doing this.

One is to aſcend from a particular thing to a general. Thus Cicero, in his defence of Archias, having commended him as an excellent poet, and likewiſe obſerved, that all the liberal arts have a connection with each other, and a mutual relation between them, in order to raiſe a juſt eſteem of him in the minds of his hearers, takes occaſion to ſay many things in praiſe of polite literature in general, and the great advantages that may be received from it. "You will aſk me (ſays he), why we are ſo delighted with this man? Becauſe he ſupplies us with thoſe things which both refreſh our minds after the noiſe of the forum, and delight our ears when wearied with contention. Do you think we could either be furniſhed with matter for ſuch a variety of ſubjects, if we did not cultivate our minds with learning; or bear ſuch a conſtant fatigue, without affording them that refreſhment? I own I have always purſued theſe ſtudies; let thoſe be aſhamed, who have ſo given up themſelves to learning, as neither to be able to convert it to any common benefit, nor diſcover it in public. But why ſhould it ſhame me, who have ſo lived for many years, that no advantage or eaſe has ever diverted me, no pleaſure allured me, nor ſleep retarded me from this purſuit. Who then can blame me, or who can juſtly be diſpleaſed with me, if I have employed that time in reviewing theſe ſtudies, which has been ſpent by others in managing their affairs, in the celebration of feſtivals, or other diverſions, in refreſhments of mind and body, in unſeaſonable banquets, in dice, or tennis? And this ought the rather to be allowed me, becauſe my ability as an orator has been improved by thoſe purſuits, which, ſuch as it is, was never wanting to aſſiſt my friends. And if it be eſteemed but ſmall, yet I am ſenſible from what ſpring I muſt draw thoſe things which are of the greateſt importance." With more to the ſame purpoſe; from which he draws this inference: "Shall I not therefore love this man? ſhall I not admire him? ſhall I not by all means defend him?"

A contrary method to the former is, to deſcend from a general to a particular. As if any one, while ſpeaking in commendation of eloquence, ſhould illuſtrate what he ſays from the example of Cicero, and ſhow the great ſervices he did his country, and the honours he gained to himſelf, by his admirable ſkill in oratory. Our common way of judging of the nature of things is from what we obſerve in particular inſtances, by which we form general notions concerning them. When therefore we conſider the character of Cicero, and the figure he made in the word, it leads us to conclude, there muſt be ſomething very admirable in that art by which he became ſo celebrated. And this method he has taken himſelf in his oration for the Manilian law, where having firſt intimated the ſcarcity of good generals at that time among the Romans, he then deſcribes the virtues of a complete commander as a proof of it, and ſhows how many and great qualifications are neceſſary to form ſuch a character, as courage, prudence, experience, and ſucceſs: all which he afterwards applies to Pompey.

A third method is by an enumeration of parts. So when Cicero, upon the defeat of Mark Antony before Mutina, propoſed that a funeral monument ſhould be erected in honour of the ſoldiers who were killed in that battle, as a comfort to their ſurviving relations; he does it in this way, to give it the greater weight: "Since (ſays he) the tribute of glory is paid to the beſt and moſt valiant citizens by the honour of a monument, let us thus comfort their relations, who will receive the greateſt conſolation in this manner; their parents who produced ſuch brave defenders of the ſtate; their children who will enjoy theſe domeſtic examples of fortitude; their wives, for the loſs of ſuch huſbands, whom it will be more fitting to extol than lament; their brethren, who will hope to reſemble them no leſs in their virtues than their aſpect. And I wiſh we may be able to remove the grief of all theſe by our reſolutions." Such repreſentations greatly enlarge the image of a thing, and afford the mind a much clearer view of it than if it were contracted into one ſingle propoſition.

Again, another method not much unlike the former is, when any thing is illuſtrated from a variety of cauſes. Thus Cicero juſtifies his behaviour in retiring, and not oppoſing his enemies, when they ſpirited up the mob in order to baniſh him, from the following reaſons, which at that time determined him to ſuch a conduct: "When (ſays he) unleſs I was given up, ſo many armed fleets ſeemed ready to attack this ſingle ſhip of the ſtate, toſſed with the tempeſts of ſeditions and diſcords, and the ſenate was now removed from the helm; when baniſhment, murder, and outrage, were threatened; when ſome, from an apprehenſion of their own danger, would not defend me; others were incited by an inveterate hatred to all good men, others thought I ſtood in the way, others took this opportunity to expreſs their reſentment, others envied the peace and tranquillity

Disposition. tranquillity of the ſtate; and upon all theſe accounts I was particularly ſtruck at: ſhould I have choſen rather to oppoſe them (I will not ſay to my own certain deſtruction, but to the greateſt danger both of you and your children), than alone to ſubmit to and undergo what threatened us all in common?" Such a number of reaſons brought together, muſt ſet a thing in a very ſtrong and clear light.

The like may be ſaid of a number and variety of effects. Thus Cicero deſcribes the force and excellence of oratory from its great and ſurpriſing effects, when he ſays, "Nothing ſeems to be more excellent, than by diſcourſe to draw the attention of a whole aſſembly, delight them, and ſway their inclinations different ways at pleaſure. This, in every free ſtate, and eſpecially in times of peace and tranquillity, has been always in the higheſt eſteem and reputation. For what is either ſo admirable, as for one only, or a very few, out of a vaſt multitude, to be able to do that which all have a natural power of doing? or ſo delightful to hear, as a judicious and ſolid diſcourſe in florid and polite language? or ſo powerful and grand, as to influence the populace, the judges, the ſenate, by the charms of eloquence? Nay, what is ſo noble, ſo generous, ſo munificent, as to afford aid to ſupplicants, to ſupport the afflicted, give ſafety, deliver from dangers, and preſerve from exile? Or what is ſo neceſſary as to be always furniſhed with arms to guard yourſelf, aſſert your right, or repel injuries? And, not to confine our thoughts wholly to the courts of juſtice or the ſenate, what is there in the arts of peace more agreeable and entertaining than good language and a fine way of ſpeaking? For it is in this eſpecially wherein we excel other animals, that we can diſcourſe together, and convey our thoughts to each other by words. Who therefore would not eſteem, and in a particular manner endeavour to ſurpaſs others in that wherein mankind principally excels brute beaſts? But to proceed to its chief advantages: What elſe would have drawn men into ſocieties, or taken them off from a wild and ſavage life, and ſoften them into a polite and civilized behaviour; or, when ſettled in communities, have reſtrained, them by laws?" Who but, after ſuch a deſcription, muſt conceive the ſtrongeſt paſſion for an art attended with ſo many great and good effects?

A thing may likewiſe be illuſtrated by its oppoſite. So the bleſſings and advantages of peace may be recommended from the miſeries and calamities of war; and thus Cicero endeavours to throw contempt upon Catiline and his party, by comparing them with the contrary ſide: "But if, omitting all theſe things with which we abound, and they want, the ſenate, the knights, the populace, the city, treaſury, revenues, all Italy, the provinces, and foreign nations; if, I ſay, omitting theſe things, we compare the cauſes themſelves in which each ſide is engaged, we may learn from thence how deſpicable they are.—For on this ſide modeſty is engaged, on that impudence; on this chaſtity, on that lewdneſs; on this integrity, on that fraud; on this piety, on that profaneneſs; on this conſtancy, on that fury; on this honour, on that baſeneſs; on this moderation, on that unbridled paſſion: In a word, equity, temperance, fortitude, prudence, and all virtues, contend with injuſtice, luxury, cowardice, raſhneſs, and all vices; plenty with want; reaſon with folly; ſobriety with madneſs; and, laſtly, good hope with deſpair. In ſuch a conteſt, did men deſert us, would not heaven ordain that ſo many and ſo great vices ſhould be defeated by theſe moſt excellent virtues?"

Gradation is another beautiful way of doing this. So when Cicero would aggravate the cruelty and barbarity of Verres for crucifying a Roman citizen, which was a ſort of puniſhment only inflicted upon ſlaves, he chooſes this way of doing it. "It is a crime (ſays he) to bind a Roman citizen, wickedneſs to whip him, and a ſort of parricide to kill him; what then muſt I call it to crucify him? No name can ſufficiently expreſs ſuch a villany." And the images of things may be thus heightened, either by aſcending, as in this inſtance; or deſcending, as in that which follows, relating to the ſame action of Verres: "Was I not to complain of or bewail theſe things to Roman citizens, nor the friends of our ſtate, nor thoſe who had heard of the Roman name; nay, if not to men, but beaſts; or, to go yet further, if in the moſt deſert wilderneſs, to ſtones and rocks; even all mute and inanimate creatures would be moved by ſo great and heinous cruelty."

And, to name no more, facts may be amplified from their circumſtances; as time, place, manner, event, and the like. But inſtances of this would carry us too far; and therefore we ſhall only add, that as the deſign of *amplification* is not barely to prove or evince the truth of things, but alſo to adorn and illuſtrate them, it requires a florid and beautiful ſtyle, conſiſting of ſtrong and emphatical words, flowing periods, harmonious numbers, lively tropes, and bright figures. But the conſideration of theſe things comes under the Third Part of Oratory, upon which we are now to enter.

PART III. OF ELOCUTION.

ELOCUTION directs us to ſuit both the words and expreſſions of a diſcourſe to the nature of the ſubject, or to ſpeak with propriety and decency. This faculty is in one word called *eloquence;* and thoſe perſons who are poſſeſſed of it are therefore ſtyled *eloquent.*

Elocution is twofold, general and particular. The former treats of the ſeveral properties and ornaments of language in common; the latter conſiders them as they are made uſe of to form different ſorts of ſtyle.

I. GENERAL ELOCUTION.

THIS, according to rhetoricians, conſiſts of three parts; *Elegance*, *Compoſition*, and *Dignity*. A diſcourſe which has all theſe properties ſuitably adjuſted, muſt, with reſpect to the language, be perfect in its kind, and delightful to the hearers. 41 General elocution defined.

CHAP.

Chap. I. *Of Elegance.*

Elegance consists in two things, *Purity* and *Perspicuity:* And both these, as well with respect to single words, as their construction in sentences. These properties in language give it the name of *elegant*, for a like reason that we call other things so which are clean and neat in their kind. But in the common use of our tongue, we are apt to confound *elegance* with *eloquence;* and say, *a discourse is elegant*, when we mean by the expression, that it has all the properties of fine language.

§ 1. *Purity.*

42 Purity explained and illustrated.

By this we are to understand the choice of such words and phrases as are suited and agreeable to the use of the language in which we speak: And so grammarians reduce the faults they oppose to it to two sorts, which they call *barbarism* and *solecism;* the former of which respects single words, and the latter their construction. But we shall consider them jointly, and in a manner different from grammarians; for with them all words are esteemed pure which are once adopted into a language, and authorised by use. And as to phrases, or forms of expression, they allow them all the same claim, which are agreeable to the analogy of the tongue. But in oratory, neither all words nor all expressions are so called which occur in language; but such only as come recommended by the authority of those who speak or write with accuracy and politeness. Indeed it is a common saying *that we should think with the learned, and speak with the vulgar.* But the meaning of that expression is no more than that we should speak agreeably to the common usage of the tongue, that every one may understand us; and not choose such words or expressions as are either difficult to be understood, or may carry in them an appearance of affectation and singularity. But in order to set this matter in a clearer light, we shall here recount the principal things which vitiate the purity of language.

And first, it often happens, that such words and forms of speaking as were introduced by the learned are afterwards dropped by them as mean and sordid, from a seeming baseness contracted by vulgar use. For polite and elegant speakers distinguish themselves by their discourse, as persons of figure do by their garb; one being the dress of the mind, as the other is of the body. And hence it comes to pass, that both have their different fashions, which are often changed; and as the vulgar affect to imitate those above them in both, this frequently occasions an alteration when either becomes too trite and common. But beside these sordid words and expressions, which are rendered so by the use of the vulgar, there is another sort first introduced by them, which is carefully to be avoided by all those who are desirous to speak well. For the vulgar have their peculiar words and phrases, suited to their circumstances, and taken from such things as usually occur in their way of life. Thus in the old comedians, many things are spoken by servants, agreeable to their character, which would be very unbecoming from the mouth of a gentleman. And we cannot but daily observe the like instances among ourselves.

Again, this is common to language with all other human productions, that it is in its own nature liable to a constant change and alteration. For, as Horace has justly observed,

> All human works shall waste;
> Then how can feeble words pretend to last.

Nothing could ever please all persons, or at least for any length of time. And there is nothing from which this can less be expected than language. For as the thoughts of men are exceedingly various, and words are the signs of their thoughts, they will be constantly inventing new signs to express them by, in order to convey their ideas with more clearness, or greater beauty. If we look into the different ages of the Latin writers, what great alterations and changes do we find in their language? How few now understand the remaining fragments of the *twelve tables?* Nay, how many words do we meet with even in Plautus, the meaning of which has not yet been fixed with certainty by the skill of the best critics? And if we consider our own language, it will appear to have been in a manner entirely changed from what it was a few ages since. To mention no others, our celebrated Chaucer is to most persons now almost unintelligible, and wants an expositor. And even since our own memory, we cannot but have observed, that many words and expressions, which a few years ago were in common use, are now in a manner laid aside and antiquated; and that others have constantly succeeded, and daily do succeed in their room. So true is that observation of the same poet:

> Some words that have or else will feel decay
> Shall be restor'd, and come again in play;
> And words now fam'd shall not be fancied long;
> They shall not please the ear, nor move the tongue:
> As use shall these approve, and those condemn;
> Use, the sole rule of speech, and judge supreme.

We must therefore no less abstain from antiquated or obsolete words and phrases, than from sordid ones. Though all old words are not to be thought antiquated. By the former we mean such as, though of an ancient standing, are not yet entirely disused nor their signification lost. And from the use of these we are not to be wholly debarred, especially when they appear more significant than any others we can fix upon. But as to phrases or expressions, greater caution seems still necessary: and such as are old should doubtless, if at all, be used more sparingly. The Latin tongue was brought to its greatest perfection in the reign of Augustus, or somewhat sooner; and he himself studied it very carefully. For, as Suetonius tells us, "He applied himself to eloquence, and the study of the liberal arts, from his childhood, with great diligence and labour. He chose a manner of speaking which was smooth and elegant; he avoided the ill savour, as he used to call it, of antiquated words; and he was wont to blame Tiberius for his affectation of them." In our own language, such words are to be esteemed antiquated, which the most polite persons have dropped, both in their discourse and writings; whose example we should follow, unless we would be thought to converse rather with the dead than the living.

But further: As on the one hand we must avoid obsolete words and phrases; so, on the other, we should refrain

Elocution. refrain from new ones, or ſuch whoſe uſe has not yet been ſufficiently eſtabliſhed, at leaſt among thoſe of the beſt taſte. Words may be conſidered as new in two reſpects; either when they are firſt brought into a language, or when they are uſed in a new ſenſe. As the former of theſe may ſometimes leave us in the dark by not being underſtood, ſo the latter are moſt apt to miſlead us; for when we hear a word that has been familiar to us, we are preſently led to fix that idea to it with which it has uſually been attended. And therefore, in both caſes, ſome previous intimation may be neceſſary. Cicero, who perhaps enlarged the furniture of the Roman tongue more than any one perſon beſides, appears always very cautious how he introduces any thing new, and generally gives notice of it when he attempts it, as appears in many inſtances ſcattered through his works. What bounds we are now to fix to the purity of the Latin tongue, in the uſe of it, the learned are not well agreed. It is certain, our furniture is much leſs than when it was a living language, and therefore the greater liberty muſt of neceſſity be ſometimes taken. So that their opinion ſeems not unadviſable, who direct us to make choice principally of what we are furniſhed with from the writers of the Auguſtan age; and where we cannot be ſupplied from them, to make uſe of ſuch authors as lived neareſt to them, either before or ſince. And as to our own tongue, it is certainly prudent to be as careful how we admit any thing into it that is uncouth or diſagreeable to its genius, as the ancient Romans were into theirs; for the perfection of a language does in a great meaſure conſiſt in a certain analogy and harmony running through the whole, by which it may be capable of being brought to a ſtandard.

But beſides thoſe things already mentioned, any miſtake in the ſenſe of words, or their conſtruction, is oppoſed to purity. For to ſpeak purely, is to ſpeak correctly. And ſuch is the nature of theſe faults in elocution, that they are often not ſo eaſy to be obſerved by hearing as by reading. Whence it is, that, many perſons are thought to ſpeak better than they write; for while they are ſpeaking, many ſlips and inaccuracies eſcape diſregarded, which in reading would preſently appear. And this is more eſpecially the caſe of perſons unacquainted with arts and literature; who, by the aſſiſtance of a lively fancy and flow of words, often ſpeak with great eaſe and freedom, and by that means pleaſe the ear; when, at the ſame time, what they ſay, would not ſo well bear reading.

We ſhall only add, that a diſtinction ought likewiſe to be made between a poetic diction and that of proſe writers. For poets in all languages have a ſort of peculiar dialect, and take greater liberties, not only in their figures, but alſo in their choice and diſpoſition of words; ſo that what is a beauty in them would often appear unnatural and affected in proſe.

§. 2. *Of Perſpicuity.*

43 Perſpicuity explained and illuſtrated.

PERSPICUITY, as well as *purity*, conſiſts partly in *ſingle words*, and partly in their *conſtruction*.

44 As to ſingle words.

I. As to *ſingle words*, thoſe are generally cleareſt and beſt underſtood which are uſed in their proper ſenſe. But it requires no ſmall attention and ſkill to be well acquainted with the force and propriety of words; which ought to be duly regarded, ſince the perſpicuity of a diſcourſe depends ſo much upon it. Elocution. Cæſar ſeems plainly to have been of this mind, when he tells us, "The foundation of eloquence conſiſts in the choice of words." It may not be amiſs, therefore, to lay down ſome few obſervations, by which the diſtinct notions of words and their peculiar force may more eaſily be perceived. All words may be divided into *proper words* and *tropes*. Thoſe are called *proper words*, which are expreſſed in their proper and uſual ſenſe. And *tropes* are ſuch words as are applied to ſome other thing than what they properly denote, by reaſon of ſome ſimilitude, relation, or contrariety between the two things. So, when a ſubtle artful man is called a *fox*, the reaſon of the name is founded in a ſimilitude of qualities. If we ſay, *Cicero will always live*, meaning *his works*, the cauſe is transferred to the effect. And when we are told, *Cæſar conquered the Gauls*, we underſtand that he did it with the aſſiſtance of his army; where a part is put for the whole, from the relation between them. And when Cicero calls Antony *a fine guardian of the ſtate*, every one perceives he means the contrary. But the nature and uſe of tropes will be explained more fully hereafter in their proper place. All words muſt at firſt have had one original and primary ſignification, which, ſtrictly ſpeaking, may be called their *proper ſenſe*. But it ſometimes happens, through length of time, that words loſe their original ſignification, and aſſume a new one, which then becomes their proper ſenſe. So *hoſtis* in the Latin tongue at firſt ſignified a *ſtranger*; but afterwards that ſenſe of the word was entirely laid aſide, and it was uſed to denote a *public enemy*. And in our language, it is well known, that the word *knave* anciently ſignified a *ſervant*. The reaſon of the change ſeems to be much the ſame, as in that of the Latin word *latro*; which firſt ſignified a *ſoldier*, but afterwards a *robber*. Beſides, in all languages, it has frequently happened, that many words have gradually varied from their firſt ſenſe to others ſomewhat different; which may, notwithſtanding, all of them, when rightly applied, be looked upon as proper. Nay, in proceſs of time, it is often difficult to ſay which is the original, or moſt proper ſenſe. Again, ſometimes two or more words may appear to have the ſame ſignification with each other, and may therefore be uſed indifferently; unleſs the beauty of the period, or ſome other particular reaſon, determine to the choice of one rather than another. Of this kind are the words *enſis* and *gladius* in the Latin tongue; and in ours, *pity* and *compaſſion*. And there are other words of ſo near an affinity to each other, or at leaſt appear ſo from vulgar uſe, that they are commonly thought to be ſynonymous. Such are the words *mercy* and *pity*; though mercy in its ſtrict ſenſe is exerciſed towards an offender, and pity reſpects one in diſtreſs. As this peculiar force and diſtinction of words is carefully to be attended to, ſo it may be known ſeveral ways. Thus the proper ſignification of ſubſtantives may be ſeen by their application to other ſubſtantives. As in the inſtance juſt now given, a perſon is ſaid to ſhow *mercy to a criminal*, and *pity to one in diſtreſs*. And in the like manner, verbs are diſtinguiſhed, by being joined to ſome certain nouns, and not to others. So a perſon is ſaid *to command an inferior*, *to intreat a ſuperior*, and *to deſire an equal*. Adjectives alſo, which denote the properties

Elocution.

properties of things, have their signification determined by those subjects to which they most properly relate. Thus we say, *an honest mind*, and *a healthful body; a wise man*, and *a fine house*. Another way of distinguishing the propriety of words, is by their use in gradations. As if one should say, *Hatreds, grudges, quarrels, tumults, seditions, wars, spring from unbridled passions*. The proper sense of words may likewise be known by observing to what other words they are either opposed, or used as equivalent. So in that passage of Cicero, where he says, "I cannot perceive why you should be angry with me: if it be because I defend him whom you accuse, why may not I be displeased with you for accusing him whom I defend? You say, I accuse my enemy; and I say, I defend my friend." Here the words *accuse* and *defend*, *friend* and *enemy*, are opposed; and *to be angry* and *displeased*, are used as terms equivalent. Lastly, the derivation of words contributes very much to determine their true meaning. Thus because the word *manners* comes from the word *man*, it may properly be applied either to that or any other put for it. And therefore we say, *the manners of men*, and *the manners of the age*, because the word *age* is there used for *the men of the age*. But if we apply the word *manners* to any other animal, it is a trope. By these and such like observations we may perceive the proper sense and peculiar force of words, either by their connection with other words, distinction from them, opposition to them, equivalency with them, or derivation. And by thus fixing their true and genuine signification, we shall easily see when they become tropes. But though words, when taken in their proper signification, generally convey the plainest and clearest sense; yet some are more forcible, sonorous, or beautiful, than others. And by these considerations we must often be determined in our choice of them. So whether we say, *he got*, or *he obtained*, *the victory*, the sense is the same; but the latter is more full and sonorous. In Latin, *timeo* signifies *I fear; pertimeo* is more full and significant; and *pertimesco* more sonorous than either of the former. The Latin and Greek languages have much the advantage of ours in this respect, by reason of their compositions; by the help of which they can often express that in one word for which we are obliged to put two words, and sometimes more. So *pertimeo* cannot be fully expressed in our language by one word; but we are forced to join one or two particles to the verb, to convey its just idea, and say, *I greatly*, or *very much fear:* and yet even then we scarce seem to reach its full force. As to tropes, though generally speaking they are not to be chosen where plainness and perspicuity of expression is only designed, and proper words may be found; yet through the penury of all languages, the use of them is often made necessary. And some of them, especially metaphors, which are taken from the similitude of things, may, when custom has rendered them familiar, be considered as proper words, and used in their stead. Thus, whether we say, *I see your meaning*, or, *I understand your meaning*, the sense is equally clear, though the latter expression is proper, and the former metaphorical, by which the action of seeing is transferred from the eyes to the mind.

45
As to the construction of sentences.

II. But *perspicuity* arises not only from a choice of *single words*, but likewise from the *construction* of them in sentences. For the meaning of all the words in a sentence, considered by themselves, may be very plain and evident; and yet, by reason of a disorderly placing them, or confusion of the parts, the sense of the whole may be very dark and obscure. Now it is certain that the most natural order is the plainest; that is, when both the words and parts of a sentence are so disposed, as best agrees with their mutual relation and dependence upon each other. And where this is changed, as is usually done, especially in the ancient languages, for the greater beauty and harmony of the periods; yet due regard is had by the best writers to the evidence and perspicuity of the expression.

But to set this subject in a clearer light, on which the perfection of language so much depends, we shall mention some few things which chiefly occasion obscurity; and this either with respect to single words, or their construction.

And first, all ambiguity of expression is one cause of obscurity. This sometimes arises from the different senses in which a word is capable of being taken. So we are told, that upon Cicero's addressing himself to Octavius Cæsar, when he thought himself in danger from his resentment, and reminding him of the many services he had done him, Octavius replied, *He came the last of his friends*. But there was a designed ambiguity in the word *last*, as it might either respect the time of his coming, or the opinion he had of his friendship. And this use of ambiguous words we sometimes meet with, not only in poetry, where the turn and wit of an epigram often rest upon it; but likewise in prose, either for pleasantry or ridicule. Thus Cicero calls Sextus Clodius *the light of the senate*, which is a compliment he pays to several great men, who had distinguished themselves by their public services to their country. But Sextus, who had a contrary character, was a relation of P. Clodius, whose dead body, after he had been killed by Milo, he carried in a tumultuous manner into the senate-house, and there burnt it with the senators benches, in order to inflame the populace against Milo. And it is in allusion to that riotous action, that Cicero, using this ambiguous expression, calls him *the light of the senate*. In such instances, therefore, it is a beauty, and not the fault we are cautioning against: as the same thing may be either good or bad, as it is differently applied.—Though even in such designed ambiguities, where one sense is aimed at, it ought to be sufficiently plain, otherwise they lose their intention. And in all serious discourses they ought carefully to be avoided. But obscurity more frequently arises from the ambiguous construction of words, which renders it difficult to determine in what sense they are to be taken. Quintilian gives us this example of it: "A certain man ordered in his will, that his heir should erect for him a statue holding a spear made of gold." A question arises here, of great consequence to the heir from the ambiguity of the expression, whether the words *made of gold* are to be applied to the *statue* or the *spear;* that is, whether it was the design of the testator by this appointment, that the whole statue, or only the spear, should be made of gold. A small note of distinction, differently placed between the parts of this sentence, would clear up the doubt, and determine the sense either way, Elocution. way. For if one comma be put after the word *ſtatue*, and another after *ſpear*, the words *made of gold* muſt be referred to the ſtatue, as if it had been ſaid, *a ſtatue, made of gold, holding a ſpear*. But if there be only the firſt comma placed after *ſtatue*, it will limit the words *made of gold* to the *ſpear* only; in the ſame ſenſe as if it had been ſaid, *A ſtatue holding a golden ſpear*. And either of theſe ways of expreſſion would in this caſe have been preferable, for avoiding the ambiguity, according to the intention of the teſtator. The ancient heathen oracles were generally delivered in ſuch ambiguous terms. Which, without doubt, were ſo contrived on purpoſe, that thoſe who gave out the anſwers might have room left for an evaſion. See ORACLE.

Again, obſcurity is occaſioned either by too ſhort and conciſe a manner of ſpeaking, or by ſentences too long and prolix; either of theſe extremes have ſometimes this bad conſequence. We find an inſtance of the former in Pliny the Elder, where ſpeaking of hellebore, he ſays, "They forbid it to be given to aged perſons and children, and leſs to women than men." The verb is wanting in the latter part of the ſentence, *and leſs to women than men:* which in ſuch caſes being uſually ſupplied from what went before, would here ſtand thus; *and they forbid it to be given leſs to women than men*. But this is directly contrary to the ſenſe of the writer, whoſe meaning is, either that it is ordered to be given in a leſs quantity to women than men, or not ſo frequently to women as men. And therefore the word *order* is here to be ſupplied, which being of a contrary ſignification to *forbid*, expreſſed in the former part of the ſentence, occaſions the obſcurity. That long periods are often attended with the ſame ill effect, muſt be ſo obvious to every one's experience, that it would be entirely needleſs to produce any examples in order to evince the truth of it. And therefore we ſhall only obſerve, that the beſt way of preventing this ſeems to be by dividing ſuch ſentences as exceed a proper length into two or more; which may generally be done without much trouble.

Another cauſe of obſcurity, not inferior to any yet mentioned, is *parentheſis*, when it is either too long or too frequent. This of Cicero, in his oration for Sylla, is longer than we uſually find in him: "O immortal gods! (for I muſt attribute to you what is your own; nor indeed can I claim ſo much to my own abilities, as to have been able of myſelf to go through ſo many, ſo great, ſuch different affairs, with that expedition, in that boiſterous tempeſt of the ſtate), you inflamed my mind with a deſire to ſave my country." But where any obſcurity ariſes from ſuch ſentences, they may frequently be remedied by much the ſame means as was juſt now hinted concerning long and prolix periods; that is, by ſeparating the parentheſis from the reſt of the ſentence, and placing it either before or after. So in this ſentence of Cicero, the parentheſis may ſtand laſt, in the following manner:—"O immortal gods! you inflamed my mind with a deſire to ſave my country: for I muſt attribute to you what is your own; nor indeed can I claim ſo much to my own abilities, as to have been able of myſelf to go through ſo many, ſo great, ſuch different affairs, with that expedition, in that boiſterous tempeſt of the ſtate." This order of the ſentence is very plain, and leſs involved than the former.

CHAP. II. *Of Compoſition.*

46 Compoſition defined and divided.

COMPOSITION, in the ſenſe it is here uſed, gives rules for the ſtructure of ſentences, with the ſeveral members, words, and ſyllables, of which they conſiſt, in ſuch a manner as may beſt contribute to the force, beauty, and evidence of the whole.

Compoſition conſiſts of four parts, which rhetoricians call *period*, *order*, *juncture*, and *number*. The firſt of theſe treats of the ſtructure of ſentences; the ſecond, of the parts of ſentences, which are words and members; and the two laſt, of the parts of words, which are letters and ſyllables. For all articulate ſounds, and even the moſt minute parts of language, come under the cognizance of oratory.

§. 1. *Of Period.*

47 Period defined and explained.

IN every ſentence or propoſition, ſomething is ſaid of ſomething. That of which ſomething is ſaid, logicians call the *ſubject*, and that which is ſaid of it, the *predicate:* but in grammatical terms, the former is *a noun ſubſtantive of the nominative caſe*, and the latter *a finite verb*, denoting affirmation, and ſome ſtate of being, acting, or ſuffering. Theſe two parts may of themſelves conſtitute a ſentence: As when we ſay, *The ſun ſhines*, or *the clock ſtrikes*, the word *ſun* and *clock* are the ſubject in theſe expreſſions, *ſhines* and *ſtrikes* imply each the copula and predicate. Moſt commonly, however, the noun and the verb are accompanied with other words, which in grammatical conſtruction are ſaid either to be connected with or to depend upon them; but in a logical conſideration they denote ſome property or circumſtance relating to them. As in the following ſentence: *a good man loves virtue for itſelf.* The ſubject of this ſentence is *a good man:* and the predicate, or thing affirmed of him, that he *loves virtue for itſelf.* But the two principal or neceſſary words, on which all the reſt depend, are *man* and *loves*. Now a ſimple ſentence conſiſts of one ſuch noun and verb, with whatever elſe is joined to either or both of them. And a compound ſentence contains two or more of them; and may be divided into ſo many diſtinct propoſitions, as there are ſuch nouns and verbs, either expreſſed or underſtood. So in the following ſentence, *Compliance gains friends, but truth procures hatred*, there are two members, each of which contains in it an entire propoſition. For, *Compliance gains friends* is one complete ſentence, and *Truth procures hatred* is another; which are connected into one compound ſentence by the particle *but*. Moreover, it frequently happens, that compound ſentences are made up of ſuch parts or members, ſome if not all of which are themſelves compounded, and contain in them two or more ſimple members. Such is that of Salluſt: "Ambition has betrayed many perſons into deceit; to ſay one thing, and to mean another; to found friendſhip and enmity, not upon reaſon, but intereſt; and to be more careful to appear honeſt, than really to be ſo." This ſentence conſiſts of four members; the laſt of which three, conſiſting of oppoſite parts, are all compounded, as will appear

appear by expreſſing them at length in the following manner; *Ambition has betrayed many perſons into deceit;* [that is, ambition] *has betrayed them to ſay one thing, and to mean another; it has betrayed them to found friendſhip and enmity, not upon reaſon, but intereſt; and it has betrayed them to be more careful to appear honeſt, than really to be ſo.* The three laſt of theſe members, beginning with the words *it betrays*, are all of them compounded, and conſiſt of two oppoſite members; which might each of them be expreſſed at length in the ſame manner, by ſupplying the ellipſis. As, *Ambition has betrayed many perſons to ſay one thing, and it has betrayed them to mean another.* And ſo of the reſt. From this inſtance we ſee how much is left to be ſupplied by the mind in all diſcourſe, which if expreſſed would both deſtroy its harmony and render it exceedingly tedious. But ſtill regard muſt be had to that which is omitted, ſo as to render what is ſaid conſiſtent with it; otherwiſe there can be no propriety in what is ſpoken. Nor can the members of a ſentence be diſtinguiſhed and duly ranged in their proper order, without this. But to proceed: Some ſentences conſiſt either wholly, or in part, of ſuch members as contain in them two or more compound ones, which may therefore, for diſtinction's ſake, be called *decompound members.*—Of this kind is that of Cicero, in his defence of Milo: "Great is the force of conſcience, great either way: that thoſe perſons are not afraid who have committed no offence; and thoſe who have offended always think puniſhment preſent before their eyes." The latter member of this ſentence, which begins with the word *that*, contains in it two compound members, which repreſent the different ſtate of mind between innocent and guilty perſons. And it is in the proper diſtinction and ſeparation of the members in ſuch complex ſentences that the art of pointing chiefly conſiſts. For the principal uſe of a comma is to divide the ſimple members, a ſemicolon the compound ones, a colon ſuch as are decompounded, and a period the whole from the following ſentence. We mention this the rather, to ſhow the different acceptation of theſe terms by grammarians, from that of the ancient writers upon oratory. For theſe latter apply them to the ſenſe, and not to any points of diſtinction. A very ſhort member, whether ſimple or compound, with them is a comma, and a longer a colon; for they have no ſuch term as a ſemicolon. Beſides, they call a very ſhort ſentence, whether ſimple or compound, a *comma*, and one of ſomewhat a greater length, a *colon.* And therefore if a perſon expreſſed himſelf either of theſe ways in any conſiderable number of ſentences together, he was ſaid to ſpeak by commas or colons. But a ſentence containing more words than will conſiſt with either of theſe terms, they call a ſimple period; the leaſt compound period with them requiring the length of two colons. However, this way of denominating ſentences, and the parts of them, rather from their length than the nature of them, appearing not ſo ſuitable, we have choſen rather to make uſe of the terms *ſimple* and *compound members;* and to call all thoſe *compound periods*, which contain two or more members, whether ſimple or compounded.

But to proceed: Sentences, with reſpect to their form or compoſition, are diſtinguiſhed into two ſorts, called by Cicero *tracta*, "ſtraight or direct;" and *contorta*, "bent or winding." By the former are meant thoſe whoſe members follow each other in a direct order, without any inflection; and by the latter, thoſe which ſtrictly ſpeaking are called *periods.* For περιοδος in Greek ſignifies a *circuit* or *circle.* And ſo the Latins call it *circuitus* and *ambitus.* By which both of them mean a ſentence conſiſting of correſpondent parts, ſo framed, that the voice in pronouncing them may have a proper elevation and cadency, and diſtinguiſh them by its inflection; and as the latter part returns back, and unites with the former, the period, like a circle, ſurrounds and incloſes the whole ſenſe. This elevation of the voice in the former part of the period, is by the Greeks called προτασις, and by the Latins *propoſitio;* and the depreſſion of it in the latter part, by the one αποδοσις, and by the other *redditio.*

Now as ſimple ſentences have not theſe correſpondent parts, which require any inflection of the voice; nor a circular form, by reaſon of their brevity; they are not properly periods, in the ſtrict ſenſe of the word: though, in common ſpeech, the words *ſentence* and *period* are often uſed as equivalent terms. Thus, if we ſay, *Generous minds are incited to the performance of noble exploits from motives of glory;* here is no diſtinction of parts, nor inflection of the voice in this ſentence. And indeed there is not any thing which relates to the ſtructure of theſe ſentences, but what will more properly be taken notice of in the ſecond part of *compoſition*, which is *order.*

And as to thoſe compound ſentences, whoſe members follow each other in a direct order, without any inflection, there is little art required in their compoſition. We ſhall produce one example of this kind from Cicero: "Natural reaſon inclines men to mutual converſe and ſociety; and implants in them a ſtrong affection for thoſe who ſpring from them; and excites them to form communities, and join in public aſſemblies; and, for theſe ends, to endeavour to procure both the neceſſaries and conveniencies of life; and that not for themſelves only, but likewiſe for their wives, children, and others who are dear to them, and have a right to their aſſiſtance." Here are five ſhort members in this ſentence, placed in a ſeries, without any inflection of the parts, or orbit of the whole. And as ſuch ſentences have no other boundary but the concluſion of the ſenſe, ſuited to the breath of the ſpeaker, he may either contract or lengthen them at pleaſure, without offending the ear. So, ſhould the ſentence laſt mentioned conclude with the firſt member in this manner, *Natural reaſon inclines men to mutual converſe and ſociety;* the ſenſe would be perfect, and the ear ſatiſfied. The caſe would be the ſame at the end of the ſecond member, thus: *Natural reaſon inclines men to mutual converſe and ſociety, and implants in them a ſtrong affection for thoſe who ſpring from them.* And the like may be ſaid of the reſt. Since ſuch ſentences therefore may be thus limited at pleaſure, it ſeems more convenient both for the ſpeaker and hearers to confine them to a moderate length.

But becauſe the principal art relating to this part of compoſition lies in the frame and ſtructure of ſuch compound ſentences as are properly called *periods*, we ſhall treat upon theſe ſomewhat more largely. In the formation

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tion of these periods, two things are chiefly to be regarded; their *length* and *cadency*. As the length ought to be suited to the breath of the speaker, the ancient rhetoricians scarce admit of more than four colons; by which we may here understand compound members of a moderate size, which will be generally found a suitable and proportionate length. For to extend them farther than the voice can well manage, must be painful to the speaker and of consequence unpleasant to the hearers. As to the cadency, what Cicero has observed, is found true by experience, that the ears judge what is full and what is deficient; and direct us to fill up our periods, that nothing be wanting of what they expect. When the voice is raised at the beginning of a sentence, they are in suspense till it be finished; and are pleased with a full and just cadency, but are sensible of any defect, and are displeased with redundancy. Therefore care must be taken that periods be neither deficient, and as it were maimed, that is, that they do not drop before their time, and defraud the ears of what seemed to be promised them; nor, on the other hand, offend them by too long and immoderate excursions. This rise and cadency of the voice in pronunciation, depend on the nature and situation of the members, as we shall endeavour to show by particular instances; in the explication of which, by the word *members*, are to be understood such as are uncompounded. In a period of two members, the turn of the voice begins with the latter member. Of this kind is the following sentence of Cicero: "If impudence prevailed as much in the forum and courts of justice, as insolence does in the country and places of less resort; Aulus Cæcina would submit as much to the impudence of Sextus Ebutius in this cause, as he did before to his insolence when assaulted by him." Here the cadency begins at the words *Aulus Cæcina*. If a sentence consist of three members, the inflection is best made at the end of the second member: for if it begin immediately after the first, the voice will be either apt to sink too low, and not be heard, before it reach the end; or else be precipitated, in order to prevent it. Cicero begins his oration for Milo with a sentence of this form: "Although I fear, it may be a shame to be dismayed at the entrance of my discourse in defence of a most valiant man; and that it nowise becomes me, while Milo is more concerned for the safety of the state than for himself, not to show the same greatness of mind in his behalf: *yet* this new form of prosecution terrifies my eyes, which, whatever way they turn, want the ancient custom of the forum, and former manner of trials." Here the cadency, beginning at the third member with the word *yet*, makes a proper division of the sentence, and easy for the speaker. But a period of four members is reckoned the most complete and perfect, where the inflection begins at the middle, that is, with the third member. Nor is it the same case here, as if, in a sentence of three members, the cadency be made at the second. For in proportion to the time of raising the voice may the space be allowed for its sinking. The following sentence of Cicero gives us an instance of this, where he speaks to his son: "Although, son Mark, having now been an hearer of Cratippus for a year, and this at Athens, you ought to abound in the precepts and doctrines of philosophy, by reason of the great character both of your instructor and the city; one of which can furnish you with knowledge, and the other with examples: yet, as I always to my advantage joined the Latin tongue with the Greek, and have done it not only in oratory, but likewise in philosophy; I think you ought to do the same, that you may be equally conversant in both languages." The turn in this period begins at the word *yet;* which standing near the middle, the voice is raised to that pitch in pronouncing the former part, as to admit of a gradual cadency, without being lost before the conclusion of the sentence. But where the sense does not suit with this division at the entrance upon the third member, it is best made at the fourth. Such is the following sentence of Cicero: "If I have any genius, which I am sensible is very small; or any readiness in speaking, wherein I do not deny but I have been much conversant; or any skill in oratory, from an acquaintance with the best arts, to which I confess I have been always inclined; *no one* has a better right to demand of me the fruit of all these things than this Aulus Cæcina." The cadency of this sentence does not begin till the words *no one;* yet it ends handsomely, and without disappointing the ear. Though indeed the three first members having each of them an inflection, check the elevation of the voice, and by that variety in the pronunciation add to the harmony of the sentence. An equality of the members should likewise be attended to in the composition of a period, the better to adjust their rise and cadency. And for this reason, in sentences of three members, where the cadency begins with the third; or in those of four members, where it begins at the fourth; it promotes the harmony to make the last member longest. This is properly the nature of rhetorical periods, which when rightly formed have both an equal beauty and dignity in their composition.

But as all discourse is made up of distinct sentences, and whenever we express our thoughts it is in some of the forms above mentioned; so the use of them is not promiscuous, but suited to answer different designs in speaking. And in this view they are considered and made use of by the orator, as will be shown hereafter.

§ 2. *Of Order.*

48 Order defined and illustrated.

By *order*, rhetoricians mean the placing each word and member of a sentence in such a manner as will most contribute to the force, beauty, or evidence of the whole.

Order is of two kinds, *natural* and *artificial*. And each of these may be considered with respect to the parts either of simple or compound sentences.

As to simple sentences, we may call that order *natural*, when all the words in a sentence are so placed, as they are connected with or follow each other in a grammatical construction. And it may properly enough admit of this name, as it is founded in the nature of a proposition, and the relation of the several words of which it consists to each other. This we explained in the last chapter, and illustrated by proper examples; and shall therefore only give one instance of it here, to introduce the subject we are now upon. And it is this: *The fame of Isocrates excited Aristotle to the profession of oratory.* Here these words, *the fame of Isocrates*, contain the subject of this sentence, with what relates to it; and all those which follow, *excited Aristotle to the profession of oratory*, make up the predicate and its dependents.

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pendents. And in both parts each word grammatically considered ſtands in its proper order of conſtruction. And this ſeems agreeable to the natural way of conveying our thoughts, which leads us firſt to expreſs the ſubject or thing of which ſome other thing is ſaid, before the predicate or that which is ſaid concerning it; and with reſpect to both, as every idea ſucceeds another in the order of our conceptions, to range it in the ſame order when we communicate them to others. Our language in the general keeps pretty much to this method. But in one thing particularly it recedes from it; and that is, in placing adjectives, which denote the properties of things, before their ſubſtantives or ſubjects, whoſe properties they are: As when it is ſaid, *Evil communication corrupts good manners.* And this we always do except ſomething follows which depends upon the adjective. So we ſay, *He was a man eminent for his virtue:* not *an eminent man.*

Artificial order, as it reſpects ſimple ſentences, has little or no regard to the natural conſtruction of words; but diſpoſes them in ſuch a manner as will be moſt agreeable to the ear, and beſt anſwer the deſign of the ſpeaker. The Latins take a much greater liberty in this reſpect than we do, or than the nature of our language will permit. Quintilian ſays, it is beſt for the verb to ſtand laſt, when there is no particular reaſon to the contrary. And he gives this reaſon for it, *becauſe the force of the ſentence lies in the verb.* So that, according to him, they ſeem to have had this view in putting the verb at the end; that as the whole ſentence is imperfect without the verb, the mind being thus held in ſuſpenſe might receive the deeper impreſſion from it at laſt. They likewiſe ſeparate ſuch words as have an immediate relation between them or dependence one upon another, and place any of them firſt or laſt as they pleaſe. In ſhort, their order ſeems in a manner arbitrary, if it does not break in upon perſpicuity, to which they uſually attend. But moſt of theſe things are unſuitable to the genius of our language. One might ſay indeed, *Convince him you cannot:* inſtead of ſaying, *You cannot convince him:* Or, *With my own eyes I ſaw it;* for, *I ſaw it with my own eyes.* And again: *In proportion to the increaſe of luxury the Roman ſtate declined:* for, *The Roman ſtate declined in proportion to the increaſe of luxury.* But this inverſion of words is proper in Engliſh compoſition only when it gives force to the expreſſion; as in the higher ſtyle it often does. It ſerves to impreſs known truths upon the mind, but is unfit for communicating the firſt principles of knowledge.

As to compound ſentences, that is, ſuch as conſiſt of two or more members, either ſimple or compounded; what relates to the words in each member ſeparately is the ſame as in ſimple ſentences. But with regard to the diſpoſition of the ſeveral members, that may be called the *natural order*, which ſo places them as they mutually depend on each other. Thus the antecedent member naturally precedes the relative; as in this expreſſion, *Men are apt to forgive themſelves what they blame in others.* In hypothetical ſentences the conditional member naturally ſtands firſt. Thus: *If Socrates be a rational creature, he is a man.* That member which expreſſes the effect of an action naturally comes laſt; as, *Though you offer ever ſo good reaſons, you will not prevail with him.* The like may be ſaid of time, with regard to things done in it; as, *The Roman eloquence ſoon declined when Cicero was dead.* And to name no more, the reaſon of a thing naturally follows that of which it is the reaſon; as thus: *All the pleaſures of life muſt be uncertain, ſince life itſelf is not ſecure.*

When this order is inverted, it may be ſtyled *artificial.* So to keep to the inſtances already given, the two members in the firſt ſentence may be thus inverted: *What they blame in others, men are apt to forgive themſelves.* In the ſecond, in this manner: *Socrates is a man, if he be a rational creature.* In the third, thus: *You will not prevail with him, though you offer ever ſo good reaſons.* And ſo in the reſt: As, *When Cicero was dead, the Roman eloquence ſoon declined;* and, *Since life itſelf is not ſecure, all the pleaſures of life muſt be uncertain.* The variety of inverſions in a ſentence may generally be greater or leſs in proportion to the number of its members. In the following ſentence of Cicero, the natural order ſeems to be this: *If that greatneſs of mind be void of juſtice, which ſhows itſelf in dangers and labours, it is blameable.* Which may be varied by changing the place of the firſt and third member, in the following manner: *That greatneſs of mind is blameable which ſhows itſelf in dangers and labours, if it want juſtice.* Or by altering the place of all the three members, thus: *That greatneſs of mind is blameable, if it be void of juſtice, which ſhows itſelf in dangers and labours.* But oftentimes one member may be included in another, as in the inſtance here given: *If that greatneſs of mind, which ſhows itſelf in dangers and labours, be void of juſtice, it is blameable.* Here the relative member is included in the conditional, which is placed firſt, and the antecedent member follows both. But in Cicero it ſtands thus: *That greatneſs of mind, which ſhows itſelf in dangers and labours, if it want juſtice, is blameable;* where the relative and conditional members are both included in the antecedent member. The Latin tongue commonly admits of a much greater variety in the tranſpoſition of members, as well as in that of ſingle words, than ſuits with our idiom. In the following ſentence the natural order is much preferable, as it beſt ſuits with the proper elevation and cadency of the voice in its pronunciation: *I am willing to remit all that is paſt, provided it may be done with ſafety.* But ſhould we invert the members, and ſay, *Provided it may be done with ſafety, I am willing to remit all that is paſt;* the harmony of the cadency would be loſt. And if the latter member be included in the former, the alteration will ſtill be worſe; as, *I am willing, provided it may be done with ſafety, to forgive all that is paſt.* Here the inflection of the voice falls upon the ſame member as before, and deſtroys the beauty of the period by its elevation afterwards. Some ſentences admit of no involution of their members. Such are thoſe whoſe members are connected by conjunctive or disjunctive particles. As, *Virtue furniſhes the mind with the trueſt pleaſure in proſperity, and affords it the greateſt comfort in adverſity.* And, *A wiſe man is neither elated by proſperity, nor depreſſed by adverſity.* And the like may be ſaid of thoſe where the latter member begins with ſome illative or redditive particle. As in theſe inſtances: *The chief thing to be regarded in life is virtue, for all other things are vain and uncertain.* And, *Though fortune is always inconſtant, yet ſhe has many votaries.* Neither of the members in any of theſe ways of expreſſion, and

Elocution. and some others which might be named, can be included one in the other. In all the examples hitherto given, the sentences consist only of simple members; and indeed compound members are not so often inverted, nor included one in another, by reason of their length. However, we shall here produce one instance of each: *Whoever considers the uncertainty of human affairs, and how frequently the greatest hopes are frustrated; he will see just reason to be always on his guard, and not place too much dependence upon things so precarious.* This sentence consists of two compound members, which here stand in their natural order, but may be thus inverted: *He will see just reason to be always on his guard, and not place too much dependence on things so precarious; whoever considers the uncertainty of human affairs, and how often the greatest hopes are frustrated.* In the following sentence one compound member is included in another: *Let us not conclude while dangers are at a distance, and do not immediately approach us, that we are secure; unless we use all necessary precaution to prevent them.* Here the natural order would be: *While dangers are at a distance, and do not immediately approach us; let us not conclude that we are secure, unless we use all necessary precaution to prevent them.*

But there are some other considerations relating to order, which, being taken from the nature of things, equally suit all languages. So, in amplifying, there should be a constant gradation from a less to a greater; as when Cicero says, *Ambition creates hatred, shyness, discords, seditions, and wars.* On the contrary, in extenuating, we should descend from a greater to a less; as if, speaking of the ancient laws of Rome, one should say, *They were so far from suffering a Roman citizen to be put to death, that they would not allow him to be whipt, or even to be bound.* In constituting any whole, we put the parts first; as, *Invention, disposition, elocution, and pronunciation, make up the art of oratory.* But in separating any whole, the parts follow: as, *The art of oratory may be divided into these four parts; invention, disposition, elocution, and pronunciation.* In every enumeration care must be taken not to mix the whole with the parts; but if it be mentioned at all, it must either be put first or last. So it would be wrong to say, *He was a man of the greatest prudence, virtue, justice, and modesty*: for the word *virtue* here contains in it the other three, and therefore should not be inserted among them. See LANGUAGE, N° 17.

§ 3. *Of Juncture and Number.*

QUINTILIAN, speaking of composition, represents a discourse as very happy in that respect, when the *order*, *juncture*, and *number*, are all just and proper. The first of these, which gives rules for the due placing of the words and members of a sentence, has been already explained. We now proceed to the other two, which relate to letters and syllables; the former treating of their connection, and the latter of their quantity.

49 The nature and use of *juncture* explained and illustrated.

I. As to *juncture*. A due attention is to be paid to the nature of the vowels, consonants, and syllables in the connection of words, with regard to the sound.

As to the *first*, when a word ends with a vowel, and the next begins either with a different vowel, or the same repeated, it usually renders the pronunciation hollow and unpleasant. For, as Quintilian has justly observed, "This makes a chasm in the sentence, and stops the course of it." For there must be some pause, in order to pronounce them both, or otherwise the sound of one will be lost. So, for instance, in pronouncing these words, *the other day*, unless you stop a little after the word *the*, the sound of *e* will not be heard; and if it is dropt, it will occasion a rougher sound, from the aspiration of *th* twice repeated so near together, as *th'other day*. Therefore to prevent both these inconveniences, we usually say, *t'other day*. But the different consonants, which together with the vowels make up those syllables, often cause a considerable difference in the pronunciation, so as to render it more or less agreeable. As, if we say, *he overdid it*, the words *he over* have not so harsh a sound as *the other*; though still they require some pause to keep them distinct. Besides, some vowels meet more amicably, and admit of a softer pronunciation than others. Those which have the weakest and smallest sound, follow best; because they occasion the least alteration of the organ in forming the two sounds. Such are *e* and *i*; and therefore, without any chasm in the sound, or hesitation of the voice, we say *he is*. But where the action of the organs is greater, and the sound stronger, the pronunciation is more difficult: as when we say, *tho' all*. For here is a contrary motion of the lips, which are first put forward in sounding the *o*, and then drawn backward to pronounce the *a*; and therefore the sound is much softer to say, *tho' every*, where their action is less. And the like ill effect commonly happens from the repetition of the same vowel: as if we say, *go on*, or, *usually act thus*. There is a considerable difference between these two expressions, in repeating the sound of the vowel, and where either of them is doubled in a single word. For then the same sound only is protracted by one continued motion of the organ; as in the words *good*, and *deem*. But here the sound is repeated again by a new action of the organ; which, if precipitated, obscures the sound of one of the vowels; and, if too much retarded, makes a chasm in the pronunciation; either of which is unpleasant to the ear.

But as the coalition of two vowels occasions an hollow and obscure sound, so the meeting of some consonants renders it very harsh and rough. Thus the words *king Xerxes*, and *public good*, when so placed have not only a roughness, but likewise a difficulty in their pronunciation, from the contrary action of the lips; which in the former are first drawn back and then forwards, but in the latter the contrary way; and in both of them with some considerable force. But this may very easily be avoided, by saying, with a little alteration in the words, *Xerxes the king*, and *the good of the public*. So likewise the words *ill company*, have a softer sound than *bad company*, for the same reason. To multiply instances of this kind seems unnecessary, which so frequently occur in all discourses.

The repetition of the same syllable at the end and beginning of words, is the last thing to be considered. And a little observation will convince us, that where this happens, it generally renders the sound either confused or unpleasant. Cicero was often rallied on account of this verse:

O fortunatam natam me consule Romam.

Every one will easily perceive a disagreeable sound in the

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the following expreſſion: "A man many times does that unadviſedly, of which he afterwards repents." The chime of the words *man many* both ſeems affected, and diſpleaſes the ear. But this will ſoon be remedied, if we ſeparate theſe two words, and ſay, "A man does that many times unadviſedly."

From the ſhort account here given of this part of compoſition, it is eaſy to perceive what things are neceſſary to render it moſt complete and accurate; which are theſe following. If a word end with a vowel, the next ought to begin with a conſonant, or ſuch a vowel whoſe ſound may agree well with the former. But if a word conclude with a conſonant, either a vowel ſhould follow, or ſuch a conſonant whoſe pronunciation will ſuit with it. And laſtly, the ſame ſyllable ought not to be repeated at the end of one word, and the beginning of the next. It has been obſerved by ſome critics, that the following verſe at the beginning of Virgil's Æneid has all theſe properties:

Arma virumque cano, Trojæ qui primus ab oris.

Where any word in this verſe ends with a vowel, the next begins with a conſonant; and where any one ends with a conſonant, the next begins with a vowel; and there is no repetition of the ſame ſound throughout the whole. But this is what rarely happens, eſpecially in our language, which abounds with conſonants. And what Quintilian ſays of the coalition of vowels, in treating upon this ſubject, ſeems applicable to the whole. "This (ſays he) is a thing not much to be dreaded; and I know not whether the neglect of it, or too great a concern about it, be worſe. It neceſſarily checks the vigour of the mind, and diverts it from matters of greater importance. And therefore, as it ſhows negligence to permit it, ſo to be in conſtant fear of it diſcovers a low genius." This was the opinion of that judicious writer. And as theſe things cannot always be attended to, it may be ſufficient to avoid them, where they prove very offenſive to the ear, and it may be done without ſome greater inconvenience. So in this ſentence, *Honeſty is the beſt policy*, the coalition of *t* and *p* in the two laſt words *beſt policy* produces a roughneſs in their pronunciation; but as the expreſſion is ſtrong, and cannot perhaps be well altered for the better, the ſound here ought to give way to the ſenſe.

50 The nature and uſe of *number*.

II. *Number.* This reſpects the quantity of ſyllables, as *Juncture* does their quality. In the Greek and Roman languages every ſyllable has its diſtinct quantity; and is either long, ſhort, or common: two or more of which joined together in a certain order make a foot, and a determinate number of theſe in a different order conſtitute their ſeveral ſorts of metre. This variety of ſounds gives a much greater harmony to their poetry, than what can ariſe only from the ſeat of the accent, and the ſimilitude of ſound at the end of two verſes, which chiefly regulate our metre. And although their proſe was not ſo confined with regard to feet, either as to the kind or place of them, as their metrical compoſitions; yet it had a ſort of meaſure, more eſpecially in the riſe and cadency of their periods. This they call *rhetorical number.* And accordingly the ancient writers upon this art acquaint us what feet are beſt ſuited to the beginning, middle, or concluſion of a ſentence. Such rules are not applicable to our language, which has not that accurate diſtinction of quantity in its ſyllables. For we are apt to confound accent with quantity, and pronounce thoſe ſyllables longeſt on which we lay the accent, though in their nature they are not ſo. As in the word *ádmirable*, where none but the firſt ſyllable *ad* is pronounced long; though that is only rendered ſo by poſition, and the two following are ſo by nature. And again, in the word *ávarice*, we ſound the firſt *a* long for the ſame reaſon, and the ſecond ſhort; contrary to the nature of both theſe vowels. However, we ſhall offer a few things that may be of ſome uſe to modulate our periods and adjuſt their cadency.

A great number of monoſyllables do not ſtand well together. For as there ought to be a greater diſtance in the pronunciation between one word and another, than between the ſyllables of the ſame word; ſuch pauſes, though ſhort, yet, when too frequent, make the ſound rough and uneven, and by that means ſpoil its harmony. And this may ſeem more neceſſary to be attended to, becauſe the Engliſh language abounds ſo much with monoſyllables. On the contrary, a continuation of many long words makes a ſentence move too ſlow and heavily. And therefore ſuch periods generally run beſt, which have a proper mixture of words of a different length. Beſides, as every word has its accent, which with us ſtands for quantity, a number either of monoſyllables, or long words, coming together, ſo far abates the harmony, as it leſſens the variety.

Again, ſeveral words of the ſame ending do not ſtand well together, eſpecially where the accent falls upon the ſame ſyllable in each of them. For this creates too great a jingle by the ſimilitude of ſound; and is apt to diſpleaſe, from an appearance of affectation. Of this kind is the following ſentence: *Nothing is more wélcome, delíghtſome, or whóleſome, than reſt to a wearied man.* In ſuch expreſſions therefore, if the order of the words cannot well be altered, ſome other word ſhould be ſubſtituted in the room of one of them at leaſt, to diverſify the ſound. So in the example here given, the ſound might be varied by ſaying, *Nothing is more wélcome, pleáſant, or whóleſome.*

But to add no more, if a ſentence end with a monoſyllable, it is apt to hurt the cadency, and diſappoint the ear; whereas words of a moderate length carry a greater force with them, by the fulneſs of their ſound, and afford the ear what it expected. And there is one ſort of monoſyllables more eſpecially, which never ſtand well at the concluſion of a period, though we frequently find them there; and theſe are the ſigns of caſes. Thus we ſay, *Avarice is a crime, which wiſe men are too often guilty of.* But the cadency would doubtleſs be more agreeable if it was altered thus: *Avarice is a crime, of which wiſe men are too often gúilty.* Every one muſt perceive, when the accent falls upon the laſt ſyllable in the ſentence, as it does if it end with *óf*, the ſound is not ſo pleaſant as when it reſts upon the preceding ſyllable in the word *gúilty*. Nor are very long words well ſuited either to the beginning or concluſion of a period; for they retard the pronunciation at firſt, and fall too heavy at the end.

Chap. III. *Of Dignity.*

51 The neceſſity of dignity in an oration.

Dignity conſiſts in the right uſe of tropes and figures. It is not ſufficient for an orator to expreſs himſelf

Elocution. felf with propriety and clearnefs, or in fmooth and harmonious periods; but his language muft likewife be fuited to the nature and importance of the fubject. And therefore, as *elegance* gives rules for the firft of thefe, and *compofition* for the fecond; fo does *dignity* for the laft of them. It is very evident, that different fubjects require a different ftyle and manner of expreffion; fince, as Quintilian fays, "What is magnificent in one difcourfe would be turgid in another; and thofe expreffions which appear low upon a fublime fubject, would fuit leffer matters: and as in a florid harangue a mean word is remarkable, and like a blemifh; fo any thing lofty and bright upon a trivial argument is difproportionate, and like a tumour upon an even furface." Now this variety in the manner of expreffion arifes in a great meafure from *tropes* and *figures*, which not only enliven and beautify a difcourfe, but give it likewife force and grandeur; for which reafon this part of elocution feems to have been called *dignity*.

Tropes and figures are diftinguifhed from each other in feveral refpects. Tropes moftly affect fingle words, but figures whole fentences. A trope conveys two ideas to the mind by means of one word; but a figure throws the fentence into a different form from the common and ufual manner of expreffion. Befides, tropes are chiefly defigned to reprefent our thoughts, but figures our paffions.

§ 1. *Of Tropes.*

52 Tropes, what.

A *trope*, which is a figure of words, has been ufually defined to be *the change of a word from its proper fignification to fome other with advantage, either as to beauty or ftrength.* The words, *with advantage*, are added in the definition, becaufe a trope ought not to be chofen, unlefs there is fome good reafon for ufing it rather than the proper word. But in what manner, or how far, it can be faid of all tropes in general, that they change the proper fignification of words, will beft appear by confidering the nature of each kind of them feparately. Now in every trope a reference is had to two things, which occafions two ideas; one of the thing expreffed, and another of that thing to which it has a refpect, and is fupplied by the mind. For all tropes are taken either from things internally related, as the whole and a part; or externally, as caufe and effect, fubject and adjunct; or from fome fimilitude that is found between them; or from a contrariety. The firft of thefe is called *fynecdoche*, the fecond *metonymy*, the third *metaphor*, and the laft *irony*. We fhall endeavour to illuftrate this by examples. When we fay, *Hannibal beat the Romans;* the meaning is, that Hannibal and his army did this. So that although in fome fenfe a part may here be faid to ftand for the whole, which makes it a *fynecdoche;* yet, ftrictly fpeaking, the word *Hannibal* does not alter its fenfe, but there is an ellipfis in the expreffion, Hannibal being put for himfelf and his army. But if we fay, *Cicero fhould be read by all lovers of eloquence;* here indeed the word *Cicero* appears to be changed from its proper fenfe, and to fignify the books of Cicero; which is a *metonymy*, the author being put for his works; and therefore fuch expreffions need not be deemed elliptical. Again, if any one, fpeaking of a fubtle and crafty man, fhould fay *he is a fox;* the meaning is, he is like a fox; which is a *metaphor;* where the word *fox* retains its proper fenfe, and denotes that animal, to which the man is compared on account of his craft. Laftly, If a perfon fay to another, *Well done;* meaning that the thing was ill done, the word *well* keeps its own fenfe; but from the manner of its pronunciation, or fome other circumftance attending the expreffion, it will be evident that the contrary is intended; which is called an *irony*. From thefe inftances it may appear in what latitude we muft underftand the common definition of a trope, which makes it to confift in the change of a word from its proper fenfe into fome other. But though in reality there are but four kinds of tropes, which are diftinguifhed by fo many different refpects which things bear one to another; yet as thefe feveral refpects are found in a variety of fubjects, and attended with different circumftances, the names of *tropes* have from hence been greatly multiplied; which, however, may all be referred to fome or other of thofe already mentioned, as will be fhown when we come to treat of them in their order. And for diftinction fake we fhall call the former *primary*, and the latter *fecondary, tropes.*

We now proceed to confider the reafons which have occafioned the introduction of tropes. And thefe, as Quintilian obferves, are three; *neceffity*, *emphafis*, and *beauty*.

1. Tropes were firft introduced from *neceffity*, deriving their origin unqueftionably in a confiderable degree from the barrennefs of language, becaufe no language which we know contains a fufficient number of proper words to exprefs all the different conceptions of our minds: but the principal caufe of their introduction feems to be that extenfive influence which imagination poffeffes over every kind of fpeech. The mind confiders the fame thing various ways; views it in different lights; compares it with other things; and obferves their feveral relations and affections; wherein they agree, and in what they differ. From all which reflections it is furnifhed with almoft an infinite number of ideas; which cannot all of them be diftinguifhed and expreffed by proper words, fince new ones occur daily. And were this poffible, yet would it be impracticable, becaufe the multitude of words muft be fo vaftly great that the memory could not retain them, nor be able to recal them as occafion required. Tropes have in a good meafure redreffed both thefe inconveniences; for by means of them the mind is not burdened with a numberlefs ftock of different words, and yet nothing feems to want a name. Thus fometimes where a word is wanting to exprefs any particular thing, it is clearly enough reprefented by the name of fome other thing, by reafon of the fimilitude between them. At other times, the caufe is fignified by the effect, the fubject by the adjunct; or the contrary. And the whole is often underftood by a part, or a part by the whole. And thus by the ufe of tropes the mind is helped to conceive of fomething not expreffed, from that which is expreffed. It is much the fame cafe, as when we have occafion to fpeak of a perfon, whofe name we are either unacquainted with, or have forgot; for by defcribing his perfon, abode, or fome other circumftances relating to him, thofe we converfe with as well underftand whom we mean, as if we mentioned his name. So the fhepherd in Virgil, when

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> And what's his name who form'd the sphere,
> And show'd the seasons of the sliding year?

Besides, it sometimes happens in a discourse, that those things are necessary to be said, which, if expressed in their proper terms, would be offensive; but being clothed with metaphors, may be conveyed to the mind with decency. Thus then the imagination never contemplates any one idea single and alone, but always along with other ideas, which may be called its *accessories*, and which often operate more forcibly upon the mind than the principal idea itself does. In their nature they are often more agreeable, and frequently also more familiar, to our conceptions; or perhaps they remind us of a greater variety of important circumstances. Hence the name of the accessory is often preferred, as, e. g. when we want to point out the time in which a state enjoyed its chief reputation, &c. the proper words might do, but the imagination suggests the flourishing period of a plant or tree; and we say "the Roman empire flourished most under Augustus:" Catiline, we say, was the *head* instead of the *leader* of his party, because the head is the principal part of the human figure.

2. A second reason above mentioned for the use of tropes was *emphasis*. Tropes do many times express things with greater force and evidence than can be done by proper words. We receive much the greater part of our knowledge by our senses. And similitudes taken from sensible things, as in metaphors, very much assist the mind in its reflections upon those things which do not come under the cognizance of the senses. For it is certain, that we are sooner and more strongly affected with sensible objects, than with things of which we can have no ideas but from the internal operations of our own minds. Nay, sometimes one bright and lively trope shall convey a fuller and more just idea of a thing than a large periphrasis. So when Virgil calls the Scipios *two thunderbolts of war*, he gives a more lively image of the rapid force and speedy success of their arms, than could have been conveyed by a long description in plain words. And in many cases the tropical use of words is so emphatical, and suited to the idea we design to excite, that in this respect it may be justly esteemed the most proper. So, *incensed with anger*, *inflamed with desire*, *fallen into an error*, are all metaphorical expressions, used in a way of similitude; and yet perhaps no proper words can be made use of, which will convey a more lively image of the thing we design to represent by them.

But *beauty* and ornament, as was observed before, have been another cause of the use of tropes. Some subjects require a more florid and elegant dress than others. When we describe or applaud, ornaments of speech and a gaiety of expression are requisite. And it is the business of an orator to entertain his hearers at the same time that he instructs them. Now Cicero, who was an admirable judge of the force and power of eloquence, has observed, that tropical expressions give the mind the greatest delight and entertainment. "I have often wondered (says he) why tropes should give greater pleasure than proper words. I imagine the reason must be, either that there is an appearance of wit in neglecting what is at hand, and making choice of something at a distance; or that the hearer is furnished with a different thought, without being led into a mistake, which affords a very agreeable pleasure: or that a whole similitude is conveyed to the mind by a single word; or that, particularly in the best and most lively metaphor, the image is presented to our sight, which is the quickest of our senses." And therefore he supposes, that "as garments were first invented from necessity, to secure us from the injuries of the weather, but improved afterwards for ornament and distinction; so the poverty of language first introduced tropes, which were afterwards increased for delight." Besides, a variety of expression is pleasing in a discourse. It is many times necessary that the same thing should be repeated; and if this be done in the same words, it will grow tiresome to the hearers, and sink their esteem of the speaker's ability. Therefore, to prevent this, it is proper the expression should be varied, that although the sense be the same, it may give the mind a new pleasure by its different dress.

We come now, in the last place, to lay down some directions proper to be observed in the choice of tropes.

And first, as every trope gives us two ideas; one, of the word expressed; and another, which, by means of that, the mind connects with it; it is necessary, that the relation between these two appear very plain and evident. For an obscure trope is always faulty, unless where some particular reason makes it necessary. And therefore tropes ought not to be too far-fetched, lest that should render them dark. For which reason Cicero says, he should not choose to call any thing destructive to a person's fortune, *the Syrtis of his patrimony*, but rather the *rock of it;* nor the *Charybdis of his estate*, but the *gulf of it.* For those who either did not know that the Syrtes were two quicksands upon the coast of Africa, or that Charybdis was a gulf in the strait of Sicily, both of them very destructive to mariners, would be at a loss to understand the meaning of the metaphor. Besides, metaphors taken from things we have seen, affect the mind more forcibly than those which are taken from such things as we have only heard of. Now there is scarcely any one who has not seen a rock or a gulf; but there are very few persons, comparatively, who have been either at Charybdis or the Syrtes. It is necessary therefore in a good trope, not only that there be a near affinity between the two ideas, but likewise that this affinity be very obvious and generally known, so that the word be no sooner pronounced but both images do immediately present themselves to the mind.

Again, as a trope ought to be very plain and evident, so likewise should it bear a due proportion to the thing it is designed to represent, so as neither to heighten nor diminish the just idea of it. Indeed, sometimes when we speak of things indefinitely, we say too much, lest we should seem to say too little. And this manner of speaking is called an *hyperbole;* which is not uncommon in the sacred writings. So, for instance, Saul and Jonathan are said to be *swifter than eagles*, *and stronger than lions*. But even in this way of expression a proportion is to be observed. For some very considerable and unusual excess of the thing in its kind is at least designed by it; which, perhaps, cannot, or however is not necessary to be defined. And therefore Quintilian blames Cato for calling the top of a hill a *wart;* because

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cauſe the proportion between the two ideas is nowiſe adequate. And ſo on the contrary Ariſtotle cenſures Euripides for calling rowing *the empire of the oar*. Poets indeed are allowed a greater liberty in this reſpect; but an orator ſhould be modeſt in his expreſſions, and take care that he neither ſo heighten nor diminiſh the natural ideas of things by tropes, as to lead his hearers into miſtakes.

But further: as a moderate uſe of tropes, juſtly applied, beautifies and enlivens a diſcourſe; ſo an exceſs of them cauſes obſcurity, by running it into abſtruſe allegories and riddles. Tropes are not the common and ordinary dreſs of our thoughts, but a foreign habit: and therefore he who fills his diſcourſe with a continued ſeries of them, ſeems to act like one who appears in public in a ſtrange dreſs: which no man of character would chooſe to do.

Moreover, as one uſe of tropes is pleaſure and entertainment, we ſhould endeavour to make choice of ſuch as are ſmooth and eaſy. But if at any time we think it neceſſary to uſe a harſh trope, it is proper to ſoften it by ſome precaution. For, as Cicero very handſomely ſays, *a trope ſhould be modeſt, ſince it ſtands in a place which does not belong to it; for which reaſon it ſhould ſeem to come thither by permiſſion, and not by force.* And therefore when he thought it harſh to ſay, *The death of Cato made the ſenate an orphan;* he guards the expreſſion by ſaying, *The death of Cato has (if I may be allowed to ſay ſo) rendered the ſenate an orphan.*

And, to add no more, care ſhould be taken how we transfer tropes from one language into another. For as they are frequently taken not only from natural things, or ſuch notions as are common to the generality of mankind, but likewiſe from the manners, cuſtoms, and occurrences of particular nations; ſo they may be very plain and obvious to thoſe among whom they took their riſe, but altogether unintelligible to others who are unacquainted with the reaſon of them. It was cuſtomary for the Roman ſoldiers to carry their money in their girdles: hence it was the ſame thing with them to ſay, *a perſon had loſt his girdle*, as that *he had loſt his money.* And becauſe the Romans wore the *toga*, which was a long gown, in time of peace, and a different garb when engaged in war, their writers ſometimes uſe the word *toga* to ſignify peace. But as neither of theſe cuſtoms is in uſe among us, ſo neither would the tropes ſuit our language, or be generally underſtood by us. And even in ſuch tropes as are taken from the common nature of things, languages very much differ. There is a very beautiful trope in the account of St Paul's ſhipwreck, where it is ſaid, *The ſhip was caught, and could not bear up into the wind.* The original word, that we tranſlate *bear up*, is αντοφθαλμειν; and properly ſignifies, *to look or keep its eyes againſt it;* which is a very ſtrong and lively image, taken from animate beings, and when applied to men, often ſignifies *to withſtand* or *reſiſt:* as, αντοφθαλμειν πολεμιω, *to reſiſt an enemy;* and Plutarch ſays of Demoſthenes, that he could not αντοφθαλμειν τω αργυριω, *look againſt* or *reſiſt the power of money.* Nothing is more common with Latin writers, than to call men of a public ſpirit and true patriots, *lumina et ornamenta reipublicæ*, that is, *the lights and ornaments of the ſtate.* And we have borrowed from them the uſe of both theſe metaphors. But becauſe tropes and figures illuſtrate and heighten the ſtyle, they call them alſo *lumina orationis*, or *the lights of a diſcourſe.* It ſometimes happens, that only the tropical ſenſe of a word is taken from one language into another, and not the proper ſignification of the ſame word. So *ſcrupulus* in Latin properly ſignifies *a little ſtone, which getting into the ſhoe hurts a perſon as he walks;* hence it is applied to the mind, and uſed to expreſs *a doubt, or uneaſy thought that gives it pain.* We have borrowed this latter ſenſe of the word, but not the former.

Art. I. Primary Tropes.

54 Metaphor, what.

I. *Metaphor.* A metaphor, as uſually defined, is, *A trope, which changes words from their proper ſignification to another different from it, by reaſon of ſome ſimilitude between them.* But that a word, when uſed metaphorically, does not alter its ſignification, but retains its proper ſenſe, was ſhown above. However, it may not be amiſs to explain this matter more fully, and ſet it in a clearer light. Every *metaphor*, then, is nothing elſe but a ſhort ſimilitude. Cicero calls it *a ſimilitude reduced to a ſingle word.* And Quintilian to the ſame purpoſe ſays, that "a metaphor is a ſhort ſimilitude, and differs from it only in this, that the former is compared to the thing we deſign to expreſs, and the latter is put for it. It is a ſimilitude, when I ſay of a man, he has acted like a lion; and a metaphor, when I ſay, he is a lion." Thus far Quintilian. Now in every ſimilitude three things are requiſite; two things that are compared together, and a third in which the ſimilitude or likeneſs between them conſiſts. And therefore, to keep to this example, when Horace calls a Roman ſoldier *a lion*, if the word *lion* did not retain its proper ſenſe, there could be no ſimilitude; becauſe there would not be two things to be compared together with reſpect to a third, which is neceſſary in every ſimilitude, and was deſigned by this expreſſion. The ſenſe of which is plainly this: *That as a lion ſeizes his prey with the greateſt fierceneſs, ſo a Roman ſoldier with like rage and fury attacked his enemies.* In the ſame manner, when Cicero calls Piſo *the vulture of the province*, his meaning is, that he was like a vulture, or acted in ſuch a manner as a vulture acts, that is, rapaciouſly. So that the real difference between a metaphor and a ſimilitude conſiſts in this; that a metaphor has not thoſe ſigns of compariſon which are expreſſed in a ſimilitude. But ſome perſons have run into miſtakes in reaſoning from tropes of this kind. For they have ſo argued from metaphorical words, as if all the affections and properties of the things expreſſed by them might be attributed to thoſe other things to which they are applied, and by that means have ſtrained the compariſon (which has uſually but one particular view), in order to make it tally in other reſpects, where there is not that ſimilitude of ideas. We will endeavour to make this evident by another example from Cicero, where he calls Mark Antony *the torch of the ſtate.* The ſimilitude between Antony and a torch lay in this: *That as a torch burns and deſtroys every thing within its reach, ſo Antony brought devaſtation and ruin wherever he came.* Now a torch has not only a property to burn, but alſo to give light; but the ſimilitude would not hold in this reſpect, nor was it at all deſigned. For Cicero never calls a wicked profligate man, as Antony was, *the light of the ſtate;* though he often gives that character to good and virtuous

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tuous men, who by their examples do as it were enlighten others, and ſhow them the way to be happy themſelves and uſeful to others. But though metaphors are uſually taken from a ſimilitude between two things, as in the inſtances here mentioned; yet ſometimes they are founded in the ſimilitude which two things bear to two others in ſome particular reſpect, by means whereof what properly belongs to one of them is transferred to the other: the former of which are called *ſimple metaphors*, and the latter *analogous*. Hence the rudder of a ſhip may be called its *reins;* for what the reins are to a horſe, that the rudder is to a ſhip in guiding and directing it. So that here is a double ſimilitude, one between a ſhip and a horſe, and another between the rudder of the former and the reins of the latter; and from the analogy between the uſe of the rudder to the one and reins to the other, the reins, which belong properly to the horſe, are applied to the ſhip. Again, ſome metaphors are reciprocal, in which the ſimilitude holds either way. Thus to ſteer and to govern are uſed reciprocally both of a ſhip and a ſtate: the proper expreſſions being, *to ſteer a ſhip, and govern a ſtate;* and the contrary metaphorical. But though we ſay, *the foot of a mountain*, borrowing the ſimilitude from animals; yet we do not ſay, on the contrary, *the bottom of an animal*, meaning his feet; and therefore that metaphor is not reciprocal. From this account therefore of the nature of a metaphor, it may be ſaid to be, *The application of a word by way of ſimilitude to ſome other thing than what it properly ſignifies.* And the plainer this ſimilitude appears, the greater beauty there is in the trope.

The uſe of metaphors is very extenſive, as large as univerſal nature. For there are ſcarce any two things which have not ſome ſimilitude between them. However, they may all be reduced to four kinds; which was the ſecond thing propoſed to be conſidered.

The firſt kind of metaphors therefore may be taken from ſimilitudes between animate beings. As where thoſe things, which properly relate to brutes, are accommodated to men; or thoſe which belong to men are applied to brutes. Of the former ſort is that joke of Cicero: *My brother being aſked by Philip, why he barked ſo?* anſwered, *Becauſe he ſaw a thief.* Here *barking*, the property of a dog, is applied to a man: And the reply does not ſeem to carry more ſeverity or harſhneſs with it than the queſtion. By the latter ſort we ſay, *a crafty fox*, and *a generous horſe;* which are affections that properly relate to men. And to this kind of metaphors may thoſe likewiſe be referred, when that which properly belongs to the ſenſes is applied to the mind. Thus we often ſay, *that we ſee a thing*, when we mean *that we underſtand* or *apprehend it.* And in the ſame ſenſe we ſay, *that we hear ſuch a thing*, or *perſon.* And by the like manner of expreſſion, a perſon is ſaid *to ſmell out a thing.* And thoſe who have a genius or diſpoſition for any art or ſcience, are ſaid *to have a taſte for it;* and ſuch as have entered upon the ſtudy of it, are ſaid *to have a touch of it.* Theſe are common ways of ſpeaking in moſt languages, and very expreſſive of what is intended by them. And we may alſo bring thoſe metaphors under this head, by which the properties and affections of men are attributed to the Deity: as, when God is ſaid *to hear, ſee, be angry, repent*, and the like; which are forms of expreſſion very frequent in the ſacred writings.

A ſecond kind of metaphors lies between inanimate things, whether natural or artificial, which bear ſome ſimilitude to each other. And this head is very extenſive. Thus we ſay, *floods of fire*, and *clouds of ſmoke*, for large quantities. And ſo likewiſe, *to inflame an account*, that is, to heighten or increaſe it; with innumerable others of the like ſort. In the two firſt of theſe inſtances, the terms proper to one element are applied to another; and as thoſe elements of fire and water are oppoſite to each other, they ſhow the extenſiveneſs of this trope, that there are no things in nature ſo contrary, but may come within the limits of it, and be accommodated to each other in a way of ſimilitude. In the laſt example, a natural action is applied to what is artificial.

A third ſort of metaphors is, when inanimate things are applied to animals, on account of ſome like properties between them. Thus Homer calls Ajax, *the bulwark of the Greeks*, on account of his valour, which like a wall defended them from the Trojans. And nothing is more common with Cicero, than to brand ill men with the character of being *the peſt of the ſtate*, by reaſon of the miſchief which they bring to the public. So likewiſe he calls Zeno the philoſopher *an acute man*, for his great diſcernment and quick perception of things; fetching the alluſion from metals when brought to an edge or a point. As, on the contrary, old Chremes in Terence calls himſelf a *ſtone*, for want of apprehenſion. And we ſay, *a gay perſon*, and *a bright genius*, by this kind of metaphor.

The fourth and laſt kind of metaphors is that by which the actions and other attributes of animals are accommodated to inanimate things. Thus Cicero, ſpeaking of Clodius, ſays: "The very altars, when they ſaw that monſter fall, ſeemed to move themſelves and aſſert their right againſt him." Here the words *ſaw, move*, and *aſſert*, are all metaphors taken from the properties of animals. And Virgil, when he would repreſent the impetuous force and rapidity of the river Araxes, ſays, *it diſdained a bridge.* And it is a very uſual epithet, which Homer gives to words, to call them πτερόεντα, or *winged*, to intimate the ſwiftneſs of ſpeech.

Laſtly, as to the choice of metaphors, thoſe are eſteemed the fineſt and ſtrongeſt, which *give life and action to inanimate things.* The reaſon of which is, becauſe they do as it were invigorate all nature, introduce new forms of beings, and repreſent their images to the ſight, which of all the ſenſes is the quickeſt, moſt active, and yet moſt unwearied. What can be more moving, or in ſtronger terms expreſs the villany of Clodius, than when Cicero ſays, "The very altars of the gods ſeemed to exult at his death." And the ſame great orator particularly commends thoſe metaphors, for their ſprightlineſs and vivacity, which are taken from the ſenſe of ſeeing; as when we ſay *a bright thought*, or *a gay expreſſion.*

However, care muſt be taken not to venture upon too bold and daring metaphors. Poets indeed claim greater liberty in this reſpect, whoſe view is often to amuſe, terrify, or delight, by heightening the juſt and natural images of things. But it is expected the orator ſhould reaſon coolly, though ſtrongly and forcibly; and not by theatrical repreſentations ſo tranſport the mind, as to take it off from reflection, unleſs perhaps on ſome particular

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But there is a very great difference in the choice of metaphors, as they are designed either to praise or dispraise. One thing may be compared to another in a great variety of respects. And the same thing may be made to appear either noble or base, virtuous or vicious, by considering it in a different light. Such metaphors, therefore, as are chosen to commend, must be taken from great and laudable things; and on the contrary, those which are designed to discommend, from things vile and contemptible. Aristotle gives us a very pleasant example of this in the poet Simonides. A certain person, who had carried the prize at a race of mules, offered him a reward to write a poem in honour of that action. Simonides thought he did not bid high enough; and therefore put him off with saying, the subject was too mean to write in praise of mules, which were the offspring of asses. But upon his being offered a larger sum, he undertook the task; and, as Aristotle observes, when he has occasion to speak of the mules in that poem, he does not mention them by that name, but calls them *the daughters of fleet and generous horses*, though he might with as much propriety have called them *the daughters of dull asses*. But it was the poet's business, in praising, to take the most advantageous part of the character. Where things are capable of such different turns, metaphorical expressions are generally most beautiful. And sometimes the same metaphor may be applied contrary ways, both in praise and dispraise, as it will suit different properties of the thing to which it refers. So a *dove*, in a metaphorical sense, may represent either *innocence* or *fear*; and an *iron heart* may denote either *courage* or *cruelty*; as a *hard head*, *strength* or *weakness of thought*. And this ambiguity in the application of metaphorical words often affords occasion for jests and concise wit. We observed before, that Cicero never calls ill men, *lights of the state*. But he once in this manner calls Sextius Clodius *the light of the senate*. For when his kinsman Publius Clodius had been killed by Milo, and his corpse was brought to Rome, Sextius raised the mob, and in a tumultuous manner carried it into the senate-house, where they burnt it, and by that means set the building on fire: For which seditious act Cicero passes that joke upon him, under the metaphor of light, which elsewhere he always uses in a good sense.

But to proceed: All forced and harsh metaphors should be avoided; the one being no less disagreeable to the mind than the other to the ear. Nor should they come too thick in a discourse. In a word, they ought not to be used, but either where a proper word is wanting, or they are more significant or beautiful than the proper word.

55 Metonymy defined and explained. II. *Metonymy*. This, as defined by Quintilian, is, *the putting one word for another*. But Vossius describes it more fully, when he calls it, "A trope, which changes the name of things that are naturally united, but in such a manner as that the one is not of the essence of the other." That a metonymy is thus distinguished from the other tropes, has been sufficiently shown already in the two last chapters. When it is said, *to put one word for another*, or, *to change the names of things*, the meaning is, that the word so used changes its sense, and denotes something different from its proper signification. Thus, when *Mars* is put for *war*, and *Ceres* for *corn*, they lose their personal sense, and stand for the effects of which those deities were said to be the cause. So likewise, when Virgil says,

He drank the frothing bowl,

the word *bowl* must necessarily signify the liquor in the bowl. And when in another place, describing the temple of Juno at Carthage, in which the actions of the Trojan war were represented, and the images of the heroes, he makes Æneas, upon discovering that of Priam among the rest, cry out,

Lo here is Priam;

it is plain the word *Priam* there must stand not for his person, but his *image* or *figure*. And this property of changing the sense of the word appears peculiar to metonymy. In treating upon a metaphor, we observed the mistake of those who teach, that a word used metaphorically loses its proper signification; whereas it only changes its place, but not its sense; being applied to a thing to which it does naturally belong, by way of similitude. And as the not attending to this has run some persons into very great absurdities, in treating upon metaphorical expressions, and reasoning from them in the tropical sense; so the like has happened to others in some instances of a metonymy, where, by misapprehending their true nature, they have reasoned from them in the literal sense, as we shall show presently. A metonymy is not so extensive as a metaphor, nor altogether so necessary: because nothing is said by a metonymy, which cannot be expressed in proper words; whereas metaphors are often used for want of proper words to express some ideas. However, metonymies are very useful in language; for they enrich a discourse with an agreeable variety, and give both force and beauty to an expression. And what we observed with relation to a metaphor, is true also of this trope: that some metonymies, even in common discourse, are more frequently made use of than the proper words in whose room they are put. So, *pale death*, *a blind way*, and *a happy state*, are very common expressions with us. And it is more usual to say, *This is such a person's hand*, or *I know his hand*, than his writing, when we intend this latter sense of the word.

We now proceed to the division of metonymies; which are commonly distinguished into four kinds, from the different manner in which things are naturally, but externally, united to one another. Now things are thus united, or one thing depends upon another, either with respect to its production, or in the manner of its existence when produced. In the former way the effect depends upon its cause, and in the latter the adjunct upon its subjects. And hence arise four sorts of metonymies, which receive their names from the *cause* and *effect*, the *subject* and the *adjunct*.

It is called a *metonymy* of the *cause*, when the external cause is put for the effect. The external cause is twofold, the agent and end, which are usually called the *efficient* and *final cause*. Of the former kind are such metonymies, where the inventor or author is put for what was invented or effected by him. Thus as, we

Elocution. we faid before, *Ceres* is fometimes put for *corn*, the ufe of which fhe was faid firft to have introduced; and *Mars* for *war*, over which he was thought to prefide. And by this way of fpeaking, any artift or writer is put for his work. So Juvenal, blaming the luxury and profufenefs of the Romans, fays, *There are few tables without Mentor:* that is, which were not made by him, or after his manner. And our Saviour fays, in the parable of the rich man and Lazarus, *They have Mofes and the prophets*, meaning the books of Mofes and the prophets. But under this fort of metonymy is included not only the agent, ftrictly fo called, but alfo any means or inftruments made ufe of in the doing of a thing, when put for the thing done. Thus, *polite literature*, is called *humanity*, becaufe it cultivates and improves the human mind. And in that expreffion of Cicero, *Words move nobody but him who underftands the tongue;* the word *tongue*, which is the inftrument of fpeech, is put for *fpeech* or *language*. And in the like fenfe, *arms* are fometimes put for *war*, and the *fword* for *flaughter*. By the fame kind of metonymy likewife any affection or quality is put for its effect. As when it is faid, *the end of government is to maintain juftice;* that is, *fuch mutual offices among men as are the effects of juftice*. And fo likewife in that of Cicero, *It is the bufinefs of magiftrates to check the levity of the multitude*, by which he means tumults occafioned by their levity. Moreover, as human affections are attributed to the Deity in a metaphorical fenfe, fo feveral parts of the human body are likewife afcribed to him by this kind of metonymy. Thus, his *hand* and his *arm* are ufed to exprefs his power, as his *ear* and *eye*, his *care* and *providence*, thefe being the inftruments of fuch effects in mankind. Metonymies of the final caufe are thofe by which the end in doing a thing is put for the thing done. As when we fay, *The watch is fet*, meaning the *watchmen*, who are appointed for that purpofe. And fo likewife that expreffion, *to make an example*, as it fignifies, *to punifh*, in order to deter others from the like crimes by fuch an example. As alfo that of Virgil,

Phillis fhould garlands crop:

by which are meant *flowers* to make garlands.

The fecond kind of metonymy puts the effect for the efficient caufe, whether the agent, or only the means and inftrument. So Virgil calls the two Scipios *the deftruction of Libya*, becaufe they were the agents who effected it. And Horace compliments his patron Mæcenas with the titles of being *his guard and honour;* that is, his guardian, and the author of his honour. But when Cicero tells the citizens of Rome, that *the death of Clodius was their fafety*, he means the occafion only of their fafety. And elfewhere he calls that a *dark hope* and *blind expectation*, the effect of which was dubious and uncertain to thofe who entertained it. And in like manner, the fons of the prophets, when they were eating the pottage which Elifha had ordered to be fet before them, cried out, *There is death in the pot;* that is, fome *deadly thing*, as is prefently after explained. And thus fweat, which is the effect of labour, is fometimes put for labour. As in the threat denounced againft Adam, *In the fweat of thy face fhalt thou eat bread*, that is, by labour in cultivating the ground. And, in allufion to this way of fpeaking, Antony the orator tells Craffus, "the improvement of the ftyle by conftant exercife, as he prefcribed, was a thing of much fweat." And *virtue is faid to be gained by fweat*, that is, continued care and exercife in fubduing the paffions, and bringing them to a proper regulation. But in thefe two expreffions there is likewife a metaphor, the effect of bodily labour being applied to that of the mind. In all thefe inftances, the effect is put for the efficient caufe. Elocution.

The third kind of metonymy is, when the fubject is put for the adjunct. By fubject here, in a large fenfe of the word, may be underftood that wherein fome other thing is contained, or about which it is converfant; as likewife the poffeffor with refpect to the thing he poffeffes; and the thing fignified, when put for the fign of it. Now, by the firft of thefe ways of fpeaking, the feat of any faculty or affection is ufed for the faculty or affection itfelf. So it is ufual to fay, *a man of a clear head*, when we mean a clear mind or underftanding; the feat of the mind being fuppofed to be in the head. And a perfon is faid *to have a warm heart*, becaufe the heart has been thought the feat of the affections. In like manner, the place where any actions are performed is put for the actions done in it. As when Cicero fays, "Do not always think of the forum, the benches, the roftra, and the fenate;" meaning the difcourfes which were ufually made in thofe places. So likewife the country, or place of refidence, is put for the inhabitants, as in that paffage of Cicero: "And to omit Greece, which always claimed the pre-eminence for eloquence, and Athens, the inventrefs of all fciences, where the art of fpeaking was invented and perfected; in this city of ours, (meaning Rome), no ftudies have prevailed more than that of eloquence:" where the words Greece and Athens ftand to denote the inhabitants of thofe places. And hither may alfo be referred thofe expreffions in which the time is put for the perfons living in it; as, *the degeneracy of the prefent age*, *the virtue of former times*. In the fecond way above-mentioned, the object is ufed for the perfon or thing employed about it: As when Cicero fays, "In time of battle the laws are filent; where by *laws* he intends the *judges*, who pronounce fentence according to law. By the third of thefe ways, in which the poffeffor is put for the thing he poffeffes, we fay, *to devour*, *deftroy*, or *ruin a man*, meaning not his *perfon* but his *eftate*. And mythologifts explain the fable of Actæon by this trope, who is faid to have been devoured by his dogs; for by dogs they underftand flatterers and parafites, who confumed his eftate and brought him to beggary. By the laft way before recited, which puts the thing fignified for the fign, ftatues and pictures are called by the names of the perfons which they reprefent: as in that jeft of Cicero upon his brother Quintus, when, as Macrobius relates, "being in the province which his brother had governed, and feeing a large portait of part of his body, holding a fhield, though Quintus was but a little man, he faid, My half brother is bigger than my whole brother." The Popifh doctrine of tranfubftantiation is founded upon an abufe of this trope. For when our Saviour, fpeaking of the bread and wine at that time before him, fays, "This is my body, and this is my blood," his plain meaning is, they were the figns of his body and blood, the thing fignified being put for the fign by this fort of metonymy. But the Papifts take the expreffion literally, which muft doubtlefs be very abfurd:

Elocution. absurd: since the words relate to the time then present, while Christ was yet living, and spoke them; when it was impossible for the bread and wine to be converted into his body and blood, it being evident to all who were present, that those elements, and his body, existed separately at the same time. But if the words are explained by this trope, the sense is plain and easy, and the way of speaking familiar to all writers. Whereas they who plead for the literal sense might with equal reason assert that those expressions above-mentioned are to be taken literally, in which several parts of the human body, as the hand, the arm, the ear, and the eye, are ascribed to the Deity; or that, when our Saviour in a metaphorical sense calls himself *a vine*, and *a door*, these words were designed to be applied to him strictly and properly, and not by way of similitude only, as is the case in all metaphors.

The fourth kind of metonymy is that wherein the adjunct is put for the subject, which is done in the same variety of ways as the former. It is therefore a metonymy of the adjunct, when the thing contained is put for that which contains it. As when Virgil says, "They lie down upon purple;" that is, upon couches dyed with purple. And again, "They crown the wine;" meaning the bowl which contained the wine, it being the custom of the ancients to deck their bowls with garlands at their entertainments. By these tropes likewise virtues and vices are put for the persons in whom they are found. As in that beautiful passage of Cicero, where, comparing the profligate army of Catiline with the forces of the state, he says, "On this side modesty is engaged, on that impudence; on this chastity, on that lewdness; on this integrity, on that deceit; on this piety, on that profaneness; on this constancy, on that fury; on this honour, on that baseness; on this moderation, on that unbridled passion; in a word, equity, temperance, fortitude, prudence, and all virtues, engage with injustice, luxury, cowardice, rashness, and all vices." And to this trope those expressions are to be referred, in which any thing is put for the object about which it is conversant. As in that saying of the wise man, "Hope deferred makes the heart sick;" where hope is put for the thing hoped for. And thus Suetonius calls the emperor Titus *the love and delight of mankind*, whose mild and obliging temper rendered him the object of those agreeable affections to all persons under his government. A third use of this trope is putting a thing for the time in which it was done. Thus we say of a person *he has served so many campaigns*, meaning so many summers, that being the usual time in which armies are drawn out into the field. Lastly, by this metonymy, the sign is put for the thing it signifies; as, *the sceptre* for *the regal dignity*, and *the sword* for *the authority of the magistrate*.

56
Synecdoche explained.

III. *Synecdoche*. This is a trope by which either the whole of a thing is put for a part of it, or a part for the whole, so that the two things, whose ideas are presented to the mind in this trope, are internally related to each other: by which, as has been shown already, it is distinguished from all the other tropes. In a *synecdoche* the word retains its proper sense, and the expression is elliptical, as will appear by the several species of it, wherein the ellipsis in most of the examples is very obvious, and may with no great difficulty be supplied. Now a thing may be considered as a whole in three different respects, which logicians call an *universal, essential, and integral whole*. An universal whole is any genus with regard to its several species: as, an *animal* with respect to *mankind* and *brutes*, or *philosophy* with respect to the several *arts* and *sciences* comprised under it. An essential whole consists of matter and form; as, a *man* of *body* and *soul*. And an integral whole is any body or quantity, with respect to the several parts of which the matter of it is composed, and into which it may be divided: as, an *human body* with respect to its *several members*; or a *year*, as divisible into *months*, *weeks*, and *days*. And thus rhetoric is an integral whole in respect to the four parts that compose it; namely, invention, disposition, elocution, and pronunciation. So likewise any aggregate body, as a civil community, which is divisible into those who govern and are governed; or any army, consisting of the general and his soldiers. As a whole therefore, in each of these acceptations of the word, is frequently put for a part, and a part for the whole; hence arise six species or sorts of synecdoche.

The first of these puts the genus for the species.— Thus, virtue in general is sometimes used to denote some particular sort of virtue. As when Cicero mentions virtue as one of the four qualifications necessary in a general, he means greatness of mind. And so persons are often commended for instances of virtue shown in their conduct, which respect only some single virtue, as justice, temperance, or the like: And in this sense Cicero calls Clodius *a deadly animal*. So when our Saviour commissions his apostles to *preach the gospel to every creature*, the meaning is, *every rational creature*. And thus likewise, *to talk to a person* sometimes denotes the same thing as to *blame* him, which is one way of talking.

The second kind of synecdoche puts the species for the genus. Thus *bread* denotes any kind of food; as when a person is said *to get his bread by his labour*. In the same way of speaking, *money* is put for any kind of wealth in general. And it is an usual expression to say, that *wine destroys more than the sword*; that is, than any *hostile arms*. And the legal form of banishment among the Romans was, to prohibit persons *the use of fire and water*; that is, *the most common and ordinary necessaries of life*, in which all others were included.

The third species of this trope is, when the essential whole is put for one of its parts; that is, either for the matter or form. Thus, in the evangelist, Mary Magdalen says, *They have taken away my Lord, and I know not where they have laid him*, meaning his *body*.— So it is usual to say of a deceased person, *He was buried at such a time*. And in the inscriptions of sepulchral monuments we frequently meet with this expression, *Here lies such a one*; that is, his *corpse*. Nor are instances uncommon in which the whole being is put for the form. Thus when Cicero says, *Those persons, live who have fled from the confinement of the body, as from a prison*; by *persons* must necessarily be understood their *souls*, which are here distinguished from and set in opposition to their *bodies*. And so Virgil represents Æneas as meeting with Dido and some of his Trojan friends in the infernal regions; by which are meant their *ghosts*.

The fourth kind of synecdoche is, when either the matter or form is put for the whole being. Thus *silver* and

and *gold* are uſed to ſignify money made of thoſe metals; as when we ſay, *I have ſo much ſilver*, or *ſo much gold*. And the word *ſoul*, both in our own and other languages, is put for the *whole perſon*. So with us, *a merry ſoul*, and *a dull ſoul;* in Cicero, *dear ſouls;* and in Horace, *candid ſouls*, are all uſed in this tropical ſenſe. But this way of ſpeaking occurs nowhere more frequently than in the ſacred writings. Thus, for inſtance, it is ſaid, *All the ſouls which came with Jacob into Egypt*, meaning the *perſons*. And again, *The ſoul that ſinneth it ſhall die;* from which expreſſion, and others of the like import, ſome perſons, by not attending to the nature of this trope, have been erroneouſly led to infer that the ſoul is naturally mortal. But ſometimes only part of the matter ſtands to expreſs the whole eſſence or being. So we imitate the Latins in uſing the word *caput* or *head* to denote either a *perſon* or *thing*. For, as with them *lepidum caput*, ſo with us *a witty head*, ſignifies the ſame as *a man of wit*. And in the ſame ſenſe, *ſo many head of cattle* means ſo *many entire cattle*.

By the fifth ſort of ſynecdoche, the whole of any material thing or quantity, whether continued or diſcrete, is put for a part of it. So when Cicero ſays, *A war is kindled through the whole world*, in compliment to his country, he calls the Roman empire *the world*. And this expreſſion is alſo uſed by hiſtorians. Thus Cornelius Nepos, ſpeaking of the quarrel between Mark Antony and Auguſtus, tells us, *that each of them deſired to be lord of the world*. And in like manner St Luke ſays, *There went out a decree from Cæſar Auguſtus, that all the world ſhould be taxed*. So in St Paul's ſhipwreck, it is ſaid, *They ran the ſhip aground*, that is, *the head of her*, for it is plain by what follows, that the ſtern was looſe. And as to diſcrete quantity, our Saviour, uſing this trope, ſaid he ſhould be *three days and three nights in the heart of the earth*. Though he did not continue three whole days and nights in the grave, but only part of the firſt and third day, and the whole ſecond day, with the two whole nights between the firſt and third day, according to our way of reckoning. For he was buried on Friday in the afternoon, and reſted in the grave that night, with the following day, which was the Jewiſh Sabbath, and was riſen on the morning of the next day. So that we muſt neceſſarily have recourſe to this ſynecdoche, which puts the whole for the part, to clear up that event.

By this kind of ſynecdoche, alſo, the plural number is ſometimes put for the ſingular. Thus St Matthew ſays, *The thieves who were crucified with our Saviour reviled him:* though it is plain from St Luke, that only one of them did ſo. It may alſo be referred to this trope, when a certain number is put for an uncertain one. So it is an uſual way of expreſſion to ſay, *I have ſeen or done ſuch a thing an hundred or a thouſand times:* when perhaps ſo many are not really intended, but only in general ſome conſiderable number.

The ſixth and laſt kind of ſynecdoche puts a part of any material thing or quantity for the whole of it. So we ſay of a man, *He ſhelters himſelf under ſuch an one's roof;* that is, *in his houſe*. And of a fleet, that it *conſiſts of ſo many ſail;* meaning, *ſo many ſhips*. And by this trope, that is aſcribed to a ſingle perſon which was done by the aſſiſtance of others, and in conjunction with them: As when it is ſaid, that *Hannibal killed forty thouſand Romans at the battle of Cannæ;* For an army is an aggregate body, of which the general is the head, and conſequently the chief part of it. And to this kind of ſynecdoche may alſo be referred ſuch expreſſions in which the ſingular number is put for the plural: as if one ſhould ſay, *A man is liable to be miſled by the influence of irregular paſſions;* meaning *all men*, or *mankind in general*. Or when leſs than the real number is put for any round number: Thus ſome ancient writers, when they ſpeak of the Grecian armada that came againſt Troy, call it a fleet of *a thouſand ſhips;* though according to Homer's liſt, it contained 1186. And ſo likewiſe the Greek interpreters of the Old Teſtament are uſually called the *Seventy;* whereas, in reality, they were ſeventy-two.

IV. *Irony*. This is *a trope in which one contrary is ſignified by another:* As if *any* one ſhould ſay, *Well done;* when at the ſame time his deſign is to intimate that the thing was *ill done*. So that, by this manner of expreſſion, the ſpeaker appears to mean ſomething contrary to the ſenſe of the word he makes uſe of. Not that the word is changed from its uſual ſignification; but by the circumſtances attending the expreſſion, we perceive the contrary to what is ſpoken is intended. Quintilian obſerves, that an irony may be known one of theſe three ways: "By the manner of pronunciation, or from the nature of the perſon or the thing. For (as he adds) where any of theſe does not ſuit with the words, it is plain the ſpeaker intends the contrary." The irony is very plain from the manner of pronunciation in that paſſage of Terence, where Simo ſpeaking to his ſervant by way of reproof, ſays, "You have taken great care indeed." From the circumſtances of the perſon, when Cicero, addreſſing to Catiline, ſays, "He went to your companion, that *excellent man*, Marcus Marcellus." When he calls him an *excellent man*, it is evident he means the contrary: becauſe no good man would be a companion of Catiline. And when he begins his oration for Ligarius with ſaying, "Cæſar, this is a *new* crime, and never heard of till now," the thing he is ſpeaking of ſhows it to be an irony; for it was not new, as all who were preſent very well underſtood. 57 Irony defined and illuſtrated.

The ſubjects of irony are vices and follies of all kinds. And this way of expoſing them is often more effectual than ſerious reaſoning: For many perſons, who, either from temper or want of reflection, cannot be moved by the force of an argument, are not proof againſt the poignancy of wit and raillery. And therefore we find the moſt grave and ſerious perſons have not declined the uſe of this trope upon proper occaſions. Socrates, whom the oracle pronounced the wiſeſt man of his age, gave ſo much into it, that he got the name of εἴρων, that is, the *droll*. In the ſacred writings we have a remarkable inſtance of it in the prophet Elijah, where he challenges the prieſts of Baal to prove the truth of their deity: For it is ſaid expreſsly, "He mocked them, and ſaid, Cry aloud, for he is a god; either he is talking, or he is purſuing, or he is on a journey, or peradventure he ſleepeth, and muſt be awaked." And Solomon takes the like method to expoſe the follies of youth by this ironical apoſtrophe, "Rejoice, O young man, in thy youth," with what

what follows, which is all ironical. Nay, our Saviour himſelf thought fit thus to reprove the Jewiſh doctors, when he ſays, "Full well ye reject the commandment of God, that ye may keep your own tradition: Where, by the words *full well*, or, as it is in the original, καλως, it is very evident that a ſevere reprimand was intended.

An irony is uſed on a variety of occaſions, as we ſhall ſhow from ſome inſtances in Cicero. Sometimes he applies it in a way of jeſt and banter: As when he ſays, "We have much reaſon to believe the modeſt man would not aſk him for his debt, when he purſues his life." At other times by way of inſult and deriſion: Thus when he would repreſent the forces of Catiline as mean and contemptible, "O terrible war, (ſays he), in which this band of rakes are to march under Catiline! Draw out all your garriſons againſt this formidable body." Again, at other times, to give the greater force to his argument, he would ſeem, as it were, by this trope to recal and correct what he had ſaid before; as in his oration for Milo: "But it is fooliſh in us to compare Druſus, Africanus, Pompey, and ourſelves, with Clodius; all our calamities were tolerable, but no one can patiently bear the death of Clodius." Now the character of Clodius was ſo well known, that all who were preſent muſt be ſenſible he meant the contrary. And, to name no more, an irony is never uſed to greater advantage, than when it is followed immediately by ſomething very ſtinging. Thus, ſpeaking of Piſo, he ſays, "You have heard this philoſopher: he denies that he was ever deſirous of a triumph." And then addreſſing himſelf to him, he immediately adds, "O wretch! when you deſtroyed the ſenate, ſold its authority, ſubjected your conſulate to the tribune, overturned the ſtate, betrayed my life and ſafety for the reward of a province; if you did not deſire a triumph, what can you pretend you did not deſire?" This muſt effectually confound the falſe gravity at that time aſſumed by Piſo.

Art. II. Secondary Tropes.

58 Secondary tropes ſimilar in nature, though not in name, to the former ones.

Secondary tropes are ſo called, becauſe they are all of the ſame nature with the former, and may be referred to ſome or other of them, though they have received different names.

They are chiefly eight in number; *Antonomaſia*, *Communication*, *Litotes*, *Euphemiſm*, *Catachreſis*, *Hyperbole*, *Metalepſis*, and *Allegory*. The three firſt of theſe are ſimple tropes, and may all be referred to a *Synecdoche*. But the five laſt are of a mixed or complex nature, and not confined to any one of the primary tropes; as will appear in treating upon them in order.

59 A common word often uſed by way of eminence for any thing remarkable.

I. A common or general word is ſometimes uſed for the proper name of ſome particular thing or perſon which upon any account is eminent and remarkable. So we ſay, *He is gone to the city*, or *he came from the city*, that is, *London*. And by the *Scriptures*, we mean the *Bible*. So likewiſe, in ſpeaking of perſons, *the orator* is uſed for Cicero, *the poet* for Homer or Virgil, and *the philoſopher* for Ariſtotle: and it is not unuſual to ſay *the apoſtle*, when we mean St Paul. On the contrary, the proper names of things or perſons are ſometimes applied to any other of the ſame character. Thus we uſe the word *goſpel* for any certain and undoubted truth. And *Carthaginian faith* proverbially ſtood for the greateſt falſehood and deceit among the Romans. With the Greeks, *Hercules* ſignified a *ſtrong man*, *Neſtor* a *wiſe man*, and *Irus* a *beggar;* and the names of *Samſon*, *Solomon*, and *Job*, now anſwer the like characters. Both theſe ways of expreſſion are often very emphatical, and heighten the idea more than where things are expreſſed by their own name. To call a good orator *Cicero*, or an excellent poet a *ſecond Virgil*, includes not only an encomium upon the arts themſelves, but leads the mind to what is moſt perfect in them, and was peculiar to thoſe perſons. Theſe forms of ſpeech are called *antonomaſia*, and come properly under a ſynecdoche; for in the former the whole is put for a part, and in the latter a part for the whole.

60 A change of perſons common in oratory.

II. Nothing is more common with orators than a change of perſons. Sometimes, to avoid envy, and prevent the imputation of pride, in aſſuming to themſelves the praiſe of any laudable action, they aſcribe it to their hearers, and do not ſay, *we*, but *ye did ſo and ſo.* At other times, when it is neceſſary to remind them of ſomething which they have done amiſs, or to caution them againſt ſome wrong ſtep for the future; to prevent giving offence, they take it upon themſelves, or at leaſt join themſelves with them, and do not ſay, *you have done this*, or *do not you do this;* but, *we have done it*, or *let us not do it.* And again, at other times, in compliment to their hearers, they join them as partners in the commendable actions or virtues of other perſons; as when the whole body of the people is brought in to ſhare the praiſe ariſing from the ſucceſs of wiſe counſels or victorious arms. Such ways of ſpeaking often occur both in Demoſthenes and Cicero. They are called *communication*, and come properly under a ſynecdoche of the whole.

61 Litotes, where, by denying the contrary, more is meant than is expreſſed.

III. On the contrary, there is a mode of ſpeech, in which, by denying the contrary, more is intended than the words expreſs. This way of ſpeaking is called *litotes;* and is often uſed for ſake of modeſty where a perſon is led to ſay any thing in his own praiſe, or to ſoften an expreſſion which in direct terms might ſound harſh or give offence. As if one ſhould ſay, *I do not commend you for that;* meaning, *I greatly diſcommend*, or *blame you for it:* where more being underſtood than the words expreſly denote, it is properly a ſynecdoche of the part. Not that this manner of ſpeaking is always to be ſo interpreted; but where it is not, there is no trope; which muſt be judged of by the circumſtances of the diſcourſe. But that it frequently is ſo uſed, might be eaſily ſhown from many inſtances; though it will be ſufficient to mention two or three. Cicero ſpeaking of Cotta, calls him *no mean orator*, whom he had juſt called *a very great orator.* And he ſays of Varro that "he purſued his ſtudies not without induſtry; and afterwards gives him the character "of a man of the greateſt application." Which paſſages, compared together, plainly ſhow the import of thoſe negative expreſſions. And a friend of Cicero, writing to him, begins his letter thus: "Although I am ſenſible the news I ſend you will not be very pleaſant." This news was concerning the death of another friend of Cicero's; and there by the words *not very pleaſant*, muſt, to be ſure, be meant *very unpleaſant and melancholy;* but he choſe that expreſſion in the beginning

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beginning of his letter, as the ſofteſt and leaſt ſhocking, the better to prepare him for the following account of what that news was. And in this way interpreters explain that paſſage in St Matthew: *And thou Bethlehem in the land of Judah art not the leaſt among the princes of Judah;* where, by *not the leaſt*, they underſtand the *greateſt*, or *very great*, upon account of the honour it received by the birth of our Saviour, as the words immediately following plainly intimate.

62
Ungrateful things ſoftened by agreeable words.

IV. When any diſpleaſing or ungrateful thing is expreſſed by a more ſoft and agreeable word, it is called *euphemiſm*. And as the word made uſe of is either contrary to the proper word, or only different from it, it may be referred to different tropes. The Latins have a ſoft way of expreſſing their diſregard to a perſon, by ſaying *valeat;* which we have borrowed from them, and ſay, *fare him well*. When the contrary being intended to what is expreſſed, it comes properly under an *irony*. And as the word *death* carries in it an idea that is diſagreeable to human nature, inſtead of ſaying a perſon is dead, we often ſay *he is deceaſed*, or *departed;* which we have alſo taken from the Latins who uſe the words *deceſſit* and *obiit* in the ſame ſenſe. So that in both languages it comes under a ſynecdoche of the whole; to depart out of life being one ſort of departure. But when the evangeliſt, ſpeaking of Stephen, who was ſtoned to death, expreſſes it by ſaying, that *he fell aſleep;* this is a beautiful metaphor, taken from the ſimilitude between the death of a good man and ſleep.

63
Catachreſis or harſh tropes.

V. *Catachreſis* ſignifies in general any harſh trope, though it is moſt commonly found in metaphors. It is principally uſed by poets, who make choice of it for novelty, or to enforce an expreſſion, where the proper word does not ſeem ſtrong enough. As when Milton, in deſcribing the angel Raphael's deſcent from heaven, ſays, he

Sails between worlds and worlds;

where the novelty of the word enlivens the image more than if he had ſaid *flies*. But it is ſometimes found in the graveſt authors, and even in the ſacred writings. So we read of the *blood of the grape*. And Solomon ſays, *the horſe-leech hath two daughters*. In all theſe inſtances the trope is a metaphor. But when St John ſays in the Revelations, *I turned to ſee the voice that ſpake to me*, it is here a metonymy of the adjunct; the word *voice* being put for the perſon who uttered it. In St Matthew we read of *Simon the leper;* not that he was then a leper, but had been ſo, and was cured; which is a *ſynecdoche* of the part. And when a criminal is ſaid *to have had his reward*, that is, his puniſhment, it is an *irony*.

94
Hyperbole the boldeſt of all tropes.

VI. *Hyperbole* is the boldeſt of all tropes; for it exceeds the ſtrict bounds of truth, and repreſents things either greater or leſs, better or worſe, than they really are. But the repreſentation is made in ſuch a manner as not to impoſe on the hearers. For an *hyperbole* is not uſed to define or deſcribe any thing accurately, but only to magnify or depreſs it in a conſiderable degree, when we either cannot or do not chooſe to repreſent it exactly. The exceſs in this trope is called *auxeſis*; as when we ſay of any thing that is very high, *it reaches to the ſkies*. The defect, or contrary extreme, is termed *meioſis*. So we ſay of a very lean perſon, *he is nothing but ſkin and bones*, or *a mere ſkeleton*. It is principally metaphorical, but ſometimes taken from other tropes. When Saul and Jonathan are ſaid to have been *ſwifter than eagles*, *and ſtronger than lions*, the expreſſion is founded in ſimilitude, and is therefore a metaphor. When, inſtead of ſaying Cato was a very virtuous man, the hiſtorian calls him *the image of virtue;* it is an hyperbolical metonymy of the adjunct for the ſubject. And when we read in the Moſaic hiſtory *of cities fenced up to heaven*, there is a *ſynecdoche*. But if a man of weak ſight be ſaid *to be eagle-eyed*, it is an *irony*. Thoſe hyperboles which are expreſſed comparatively, are commonly moſt emphatical, becauſe they ſhow a peculiarity in the exceſs. To ſay a thing is *as light as a feather*, carries the idea very far; but to ſay *it is lighter*, not only carries it ſtill farther, but alſo heightens it, by leaving the mind at an uncertainty where to fix the limits.

65
Metalepſis, where two or more tropes are meant under one word.

VII. Sometimes two or more tropes and thoſe of a different kind, are contained under one word; ſo that ſeveral gradations, or intervening ſenſes, come between the word that is expreſſed, and the thing deſigned by it. And this is called a *metalepſis*. The conteſts between Sylla and Marius proved very fatal to the Roman ſtate. Julius Cæſar was then a young man. But Sylla obſerving his aſpiring genius, ſaid of him, "In one Cæſar there are many Mariuſes." Now in this expreſſion there is a metalepſis. For the word *Marius*, by a *ſynecdoche*, or *antonomaſia*, is put for any ambitious and turbulent perſon; and this again, by a *metonymy* of the cauſe, for the ill effects of ſuch a temper to the public. So that Sylla's meaning, diveſted of theſe tropes, was, that Cæſar would prove the moſt dangerous perſon to the Roman ſtate that ever was bred in it: which afterwards proved true in the event. So when Virgil, deſcribing that part of the African coaſt where Æneas arrived with his ſhips, ſays, *A dark wood hung over it;* the word *dark*, by a metonymy of the effect, is put for *ſhady*, and that again by the ſame trope for *thick;* his meaning is, a *thick wood*. But the words of Dido, in the ſame poet, contain a larger gradation, when ſhe ſays,

Happy, ah truly happy, had I been,
If Trojan ſhips our coaſts had never ſeen.

In which expreſſion, firſt by a metonymy of the adjunct, the ſhips are put for the Trojans in the ſhips: and theſe, by a ſynecdoche of the whole, for Æneas, who was one of them; and again his arriving on the coaſt, by a metonymy of the cauſe, for her ſeeing him; and laſtly, her ſeeing him, by the ſame trope, for the paſſion ſhe had for him. So that her meaning is, ſhe had been happy, if ſhe had never entertained a paſſion for Æneas. This trope is more frequently to be met with in poets than in orators, as they take greater liberty in uſing diſtant alluſions than is ſuited to that perſpicuity of expreſſion which is required in oratory. But as Quintilian has well obſerved, all the intermediate links of the chain in this trope are of no further uſe than to lead the mind gradually from the firſt to the laſt, the better to perceive their connection. As in the example laſt mentioned, relating to Dido, if we drop all the intervening ſteps, and connect the words expreſſed with what is directly intended, they will be found to contain a very remote cauſe put for the effect, which comes under

der a metonymy. On the contrary, in the ſecond example, where *dark* ſtands for *thick*, the effect is put for a remote cauſe. And the firſt, which is founded in a ſimilitude of temper between Cæſar and Marius, belongs to a *metaphor*.

66 Allegory, a continuation of tropes thro' ſeveral ſentences.

VIII. *Allegory*. As a metalepſis compriſes ſeveral tropes in one word, ſo this is a continuation of ſeveral tropes in one or more ſentences. Thus Cicero ſays, "Fortune provided you no field, in which your virtue could run and diſplay itſelf:" where the words *field* and *run* are metaphors taken from corporeal things, and applied to the mind. And in another paſſage, ſpeaking of himſelf, he ſays, "Nor was I ſo timorous, that after I had ſteered the ſhip of the ſtate through the greateſt ſtorms and waves, and brought her ſafe into port, I ſhould fear the cloud of your forehead, or your colleague's peſtilent breath. I ſaw other winds, I perceived other ſtorms, I did not withdraw from other impending tempeſts; but expoſed myſelf ſingly to them for the common ſafety." Here the ſtate is compared to a ſhip, and all the things ſaid of it under that image are expreſſed in metaphors made uſe of to ſignify the dangers with which it had been threatened. And indeed allegories generally conſiſt of metaphors; which being the moſt beautiful trope, a number of them well choſen and put together is one of the fineſt and brighteſt ornaments in language, and exceeds a ſingle metaphor in luſtre, as à conſtellation does a ſeparate ſtar. It is true, that allegories are ſometimes found in other tropes; but this is very rare. In that known expreſſion of Terence, the tropes are all metonymies: *Without Ceres and Bacchus, Venus grows cold;* that is, diveſted of the tropes, *Without meat and drink, love dies*. And Samſon's riddle is made up of ſynecdoches: "Out of the eater came forth meat, and out of the ſtrong came forth ſweetneſs." But there is no ſmall ſkill required in the right management of allegories. For care ſhould be taken that the ſame kind of trope be carried through the whole, ſo as to compoſe one uniform and conſiſtent ſet of ideas: otherwiſe they dreſs up a chimera, a thing that has no exiſtence, and of which the mind can form no perception. And, as Quintilian ſays very juſtly, "to begin with a tempeſt and end with a fire, would be very ridiculous and unnatural." It is likewiſe very neceſſary that the alluſions be all plain and evident, eſpecially where the name of the thing alluded to is not expreſſed. Theſe are called *pure allegories*. As that of Cicero: "So it happens, that I, whoſe buſineſs it is to repel the darts, and heal the wounds, am obliged to appear before the adverſaries have thrown any dart; and they are allowed a time to attack us, when it will not be in our power to avoid the aſſault; and if they throw a poiſonous dart, which they ſeem prepared to do, we ſhall have no opportunity to apply a remedy." The tropes here are all taken from military affairs, without any intimation what they are applied to. But that is plain from the context of the diſcourſe. For he is ſpeaking of the diſadvantages he laboured under in defending his client againſt thoſe of the oppoſite ſide, and ſo applies to the bar thoſe terms which were proper to the field. But where the reference is not evident, it becomes a riddle: which is nothing elſe but an obſcure allegory. To avoid this, therefore, the beſt writers generally uſe what they call *mixed allegories;* that is, ſuch wherein the proper name of the thing is expreſſed, which the whole ſimilitude reſpects. Of this kind is that in the ſpeech of King Philip of Macedon, given us by Juſtin, where he ſays, "I perceive that cloud of a dreadful and bloody war ariſing in Italy, and a thunder-ſtorm from the weſt, which will fill all places with a large ſhower of blood, wherever the tempeſt of victory ſhall carry it." The proper words *war*, *blood*, and *victory*, being joined to the tropes *cloud*, *ſhower*, and *tempeſt*, in this ſentence, render the ſeveral parts of the ſimilitude plain and evident. Quintilian thinks thoſe allegories moſt beautiful, where the whole ſimilitude is expreſſed, and thoſe words, which in their proper ſenſe relate to one of the two things between which the compariſon is made, are allegorically applied to the other: As when Cornelius Nepos ſays of Atticus, "If that pilot gain the greateſt reputation who preſerves his ſhip in a boiſterous and rocky ſea; ought not he to be thought a man of ſingular prudence, who arrived in ſafety through ſo many and ſo great civil tempeſts?" Theſe are the allegories with which orators are chiefly concerned.

§ 2. *Of Figures*.

67 The term *figure* apparently borrowed from the ſtage.

This term ſeems have been borrowed from the ſtage, where the different habits and geſtures of the actors, ſuitable to the ſeveral characters they ſuſtained, were by the Greeks called σχηματα, and by the Latins *figuræ:* And it is not unuſual with us to ſay of a perſon, both with reſpect to his dreſs and action, that he makes *a very bad*, or *a very graceful*, *figure*. And as language is the dreſs, as it were of our thoughts, in which they appear and are repreſented to others; ſo any particular manner of ſpeaking, may, in a large ſenſe of the word, be called its *figure*, in which latitude writers ſometimes uſe it. But rhetoricians have reſtrained the ſenſe of the word to ſuch forms of ſpeech as differ from the more common and ordinary ways of expreſſion; as the theatrical habits of actors, and their deportment on the ſtage, are different from their uſual garb and behaviour at other times. A *figure* therefore, in the ſenſe it is uſed by rhetoricians, is *A mode of ſpeaking different from, and more beautiful and emphatical than, the ordinary and uſual way of expreſſing the ſame ſenſe*; or, in other words, *That language which is ſuggeſted either by the imagination or the paſſions*. Now as the habits and geſtures of our bodies are in a manner infinitely variable, ſo it is plain that the different forms of ſpeech are almoſt innumerable. But every alteration from the common manner ought not to be eſteemed a figure, nor deſerves that character. It muſt contain ſome beauty, or expreſs ſome paſſion, to merit a place among rhetorical figures, and be marked out for imitation.

The ſubject of *figure* ſeems to have been one of the laſt things which was brought into the art of oratory, in order to complete it. Ariſtotle, who treats ſo accurately upon other parts, ſays very little of this. But the Greek writers who came after him have abundantly ſupplied that deficiency. It is to them we owe the chief obſervations that have been made on this ſubject. They took notice of the ſeveral modes and turns of expreſſion, obſerved their force and beauty, and gave them particular names by which they might be known and diſtinguiſhed from each other. And indeed

Elocution. indeed they have treated the matter with ſuch minuteneſs and ſubtility, that Quintilian ſeems, not without reaſon, to think they have multiplied figures to an exceſs. But though it was ſo late before they were taken notice of, and introduced into the art of ſpeaking, yet the uſe of them in diſcourſe was doubtleſs very antient. The author of Homer's life, which ſome have aſcribed to Plutarch, has ſhown, by examples taken out of him, that there is ſcarce a figure mentioned by rhetoricians, but is to be met with in that moſt ancient poet. And, if we conſider the nature of ſpeech, we ſhall eaſily perceive that mankind muſt have been under a neceſſity very early to introduce the uſe of *tropes* for ſupplying the want of proper words to expreſs their ſimple ideas: ſo the like neceſſity muſt have put them upon the uſe of figures to repreſent their different paſſions; though both of them were afterwards increaſed, and improved in ſuch a manner as to become the chief ornaments of language. The paſſions of men have been always the ſame; they are implanted in us by nature, and we are all taught to diſcover them by the ſame ways. When the mind is diſturbed, we ſhow it by our countenance, by our actions, and by our words. Fear, joy, anger, alter the countenance, and occaſion different emotions and geſtures of the whole body. And we know with what paſſion a man is affected, by hearing his words, though we do not ſee him. He does not expreſs himſelf as he uſually does at other times when cool and ſedate. Objects appear to him in a different view, and therefore he cannot but ſpeak of them in a different way. He interrogates, he exclaims, he admires, he appeals, he invokes, he threatens, he recals his words, repeats them, and by many other different turns of expreſſion varies his ſpeech no leſs than his countenance, from his common and ordinary manner. Now as nature ſeems to teach us by theſe figurative expreſſions how to repreſent the different commotions of our minds, hence ſome have thought fit to call figures *the language of the paſſions*. And as theſe are given us, among other wiſe ends, to excite us the better to provide for our preſervation and ſafety, this is done ſometimes by force of arms, and at other times by diſcourſe. And therefore Cicero very handſomely compares the conduct of an orator to the exerciſes of the palæſtra: in which, as each combatant endeavours not only to defend himſelf, and attack his adverſary, but likewiſe to do both with decency; ſo the principal weapons of an orator, as he repreſents them, are figures, which being no leſs the ornaments of language than images of our paſſions, anſwer all theſe purpoſes. Beſides, figures chiefly diſtinguiſh the different kinds of ſtyle, furniſh it with an agreeable variety, and often ſerve to repreſent things in a clear and forcible manner.

From this ſhort account of the nature of figures, the advantage of them to an orator is very evident. They are a ſort of natural eloquence, which every one falls into without attending to it, ſuitably to that temper of mind with which he is affected himſelf, and is deſirous to affect others. In a cool and ſedate diſcourſe, ſuch figures as convey our ſentiments with the greateſt ſtrength and evidence are moſt proper. And there are others, which are ſuited to brighten and enliven more gay and ſprightly ſubjects. Others again are more peculiarly adapted to expreſs the diſorders and perturbations of the mind. To repeat the ſame thing again would many times be deemed a tautology and impertinent; but to do this when the mind is ruffled, is not only allowable, but the repetition renders it more ſtrong and affecting. So likewiſe to interrogate, exclaim, or admire, under the influence of a paſſion, impreſſes the hearers, and diſpoſes them to attention; whereas at another time perhaps ſuch ways of ſpeaking would ſcarce be conſiſtent with prudence. There is a natural ſympathy in men's minds, which diſpoſes them to receive impreſſions from thoſe with whom they converſe. Thus one gay and pleaſant companion gives a cheerfulneſs and vivacity to a whole company; whereas, on the contrary, one who is dull and phlegmatic damps the ſpirits of all about him, and affects them with the ſame gloomy temper. Figures are peculiarly ſerviceable to an orator for anſwering theſe different intentions. And as he finds them in life, from thence he muſt copy them; as a painter does the features of the countenance, and the ſeveral parts of the body; figures being to the one what lines and colours are to the other. The deſign of Catiline to deſtroy the Roman ſtate and burn the city, is a ſtory well known. There was an army drawn together at a proper diſtance to favour the undertaking; and others were left in Rome, who had their parts aſſigned them for burning the city, and deſtroying thoſe who ſhould eſcape the flames. And, in a word, every thing was ready for putting in execution this horrid and barbarous ſcheme. So that nothing retarded it but the taking off Cicero, who was then conſul, which was thought neceſſary to be done firſt. Cicero, upon information of the deſign againſt his life, finds means to prevent it, and the ſame day calls together the ſenate. And Catiline, who was a man of conſummate boldneſs, had the confidence to appear in that aſſembly. Upon their meeting, Cicero opens to them the whole affair of the conſpiracy, and the deſign againſt himſelf, in a moſt warm and pathetic harangue. In which he had two things in view; to raiſe the indignation of the ſenate againſt the conſpirators, and particularly againſt Catiline; and, either by terrifying or exaſperating him, to oblige him to leave the city. Now he does not begin this ſpeech in his uſual manner at other times, by addreſſing to his audience, beſpeaking their favour and attention, or letting them gradually into the deſign of what he was about to ſay; but as Catiline was preſent, he immediately falls upon him with vehemence, in the following manner: "How far, Catiline, will you abuſe our patience? How long will your fury inſult us? What bounds will you ſet to your unbridled rage? Does neither the night-guard of the palace, nor the city-watch, nor the people's fear, nor the agreement of all good men, nor the meeting of the ſenate in this fortified place, nor the countenances and looks of this aſſembly, at all move you? Do not you perceive your deſigns are diſcovered, and that all who are preſent know of your conſpiracy? Who of us, do you think, is ignorant of what you did the laſt night, and the night before, where you was, who was with you, and what you reſolved on? O times, O manners! The ſenate knows this, the conſul ſees it; and yet this man lives! —lives? nay, comes into the ſenate, joins in the public counſels, obſerves and marks out each of us for deſtruction!" And in the ſame impetuous ſtrain he proceeds through

through his whole ſpeech, interſperſing a great variety of the like ſtrong and moving figures. And the diſcourſe had its deſired effect: for when Catiline ſtood up afterwards to make his defence, the whole ſenate was ſo inflamed, and their reſentments againſt him roſe ſo high, from what Cicero had ſaid, that they had not patience to hear him ſpeak; upon which he left both them and the city. Had Cicero, inſtead of venting his juſt indignation againſt the author of ſo barbarous and inhuman a deſign, in the manner he did, by figures ſuited to ſtrike the paſſions of his hearers; had he, inſtead of this, attempted to reaſon with him, and told the ſtory in a cold and lifeleſs manner, he would have expoſed himſelf to the contempt of Catiline; and by leaving the ſenate little or nothing moved at what he ſaid, prevented perhaps their coming to thoſe ſpeedy and vigorous reſolutions which were neceſſary at ſo critical a juncture. Let us ſuppoſe him to have expoſtulated with Catiline in much the ſame words as before, but thrown into a different form, and diveſted of thoſe pathetic figures. As thus: "Catiline, you have really abuſed our patience to a great degree. You have inſulted us with your furious proceedings a long while. You ſeem to have fixed no bounds to your unbridled rage. Neither the night-guard of the palace, nor the city-watch, nor the people's fear, nor the agreement among good men, nor the calling together of the ſenate in this fortified place, nor the countenances and looks of this aſſembly, appear to move you in the leaſt. I aſſure you we are all of us appriſed of what you did the laſt night, and the night before, where you was, and who were with you, and what reſolutions you came to. Theſe are ſad times, the age is very degenerate; that the ſenate ſhould know all this, the conſul ſee it; and yet that this man ſhould live, come into the ſenate, hear all our debates, and mark us out to deſtroy us." You ſee the ſenſe is entirely the ſame, and the words too in a great meaſure; ſo that there is little more than an alteration in the form of them. And yet who does not perceive how flat and languid ſuch a way of talking muſt have appeared at that time? and how much it loſes of that ſpirit and energy, which ſhows itſelf in Cicero's manner of expreſſion? Had he delivered himſelf thus, it might indeed have made the ſenate look upon Catiline as an abandoned wretch, loſt to all virtue and goodneſs, and perhaps have moved ſome to pity him on that account; as we are eaſily induced to compaſſionate perſons in ſuch circumſtances, eſpecially when deſcended from noble and virtuous anceſtors, which was his caſe. But ſure it would have been ill ſuited to fire their minds with that generous regard for their country, and the neceſſary precautions for its ſecurity, which the circumſtances of the ſtate then required. Nor would Catiline have been at all deterred by it, but rather encouraged in the proſecution of his deſigns, from the little effect a ſpeech ſo managed muſt probably have had upon the minds of the ſenators. But Cicero knew very well that the paſſions of mankind are the ſprings of action: that it is many times not ſufficient for an orator to convince their minds, by ſetting the truth in a clear light; but he muſt alſo raiſe their hopes, alarm their fears, inflame their anger, or excite ſome other ſuitable paſſion, before they will be brought to act with that zeal and fervour which the caſe may require. And as he was admirably well ſkilled in this art of touching the paſſions, he ſeldom fails to fix upon the proper methods of doing it, and makes choice of ſuch figures and modes of ſpeaking as in the ſtrongeſt manner repreſent the emotions of his own mind. For every paſſion is not to be expreſſed by the ſame figures, any more than it is drawn by the ſame lines, or painted with the ſame colours. When Dido finds that Æneas is about to leave her, ſhe uſes all her arts to detain him. And as perſons in great diſtreſs are ſeldom at a loſs to expreſs their condition in the moſt affecting way; ſhe diſcovers her fear, anger, revenge, with the whole crowd of diſorders which then poſſeſſed her mind, in a variety of moving figures, ſuited to raiſe the counter paſſions in his breaſt, as is finely repreſented by Virgil in that artful ſpeech he has made for her, which we forbear to recite for no other reaſon but the length of it. But what particular figures are moſt accommodated to anſwer the ſeveral ends propoſed by them, will beſt appear when we come to treat of them ſeparately.

We ſhall therefore now proceed to lay down a few directions for the proper uſe of figures. And firſt they ſhould always be accommodated to the ſentiments, and riſe in proportion to the images deſigned to be conveyed by them. So far as they are founded in reaſon, they are ſuited to impreſs the mind; but where the language outſtrips the thought, though it may pleaſe the ear, and ſome weak perſons may be carried away with a pomp of words, yet an intelligent hearer will ſoon ſee through the thin and airy dreſs. It is the ſenſe which gives weight to the figure, as that by ſtriking the imagination awakens the mind, and excites it to act in conformity to reaſon. Again, in the uſe of pathetic figures, it is generally better to be nervous than copious, that the images, by their cloſer union, may impreſs the mind with greater force and energy; though in ſuch figures as are deſigned for ornament or illuſtration, a more diffuſive way of painting is ſometimes agreeable. But farther, the too frequent uſe of figures ought to be avoided. For what was obſerved in relation to tropes, is alſo true with reſpect to theſe; that a great number of them is apt to darken and obſcure the ſtyle. And beſides, Cicero's reflection in this caſe is very juſt, That "it is hard to ſay, what ſhould be the reaſon, that thoſe things, which moſt affect us with a ſenſible pleaſure, and at firſt ſight ſooneſt move us, do likewiſe ſooneſt cloy and ſatiate us." But that it is ſo, we find by common experience. Laſtly, figures ſhould be ſo interwoven in a diſcourſe, as not to render the ſtyle rough and uneven, ſometimes high and at other times low; now dry and jejune, then pompous and florid. In a word, they ſhould rather ſeem to ariſe from nature than art; to offer themſelves, than to be the effect of ſtudy; and to appear not like patches upon a face, but the agreeable beauty of a ſound and healthful complexion. But of this we ſhall have occaſion to ſpeak more at large hereafter, in treating upon the different kinds or characters of ſtyle.

As to the diviſion of figures, which is what remains to be conſidered, they are uſually divided into two ſorts, figures of words, and figures of ſentences. The difference between them conſiſts in this; that in the former, if you alter the words, or ſometimes only the ſituation of them, you deſtroy the figure; but in the latter the figure remains, whatever words are made uſe of, of, or in what manner ſoever the order of them is changed. Thus when the name of a perſon or thing is repeated, to intimate ſome known property or quality belonging thereto, it is a verbal figure called *place*. Cicero was a true patriot and hearty lover of his country. And therefore we ſhall uſe this figure in ſaying, that *at the time of Catiline's conſpiracy Cicero appeared like Cicero*. The ſenſe would remain the ſame, but the figure would be loſt, if we ſhould alter the words, and ſay, *at that time Cicero appeared like himſelf*. So when two or more ſentences, or members of a ſentence, end with the ſame word, it is called *epiſtrophe;* as when we ſay, *To loſe all reliſh of life, is in effect to loſe life*. But if only the order of the words be changed in the latter clauſe thus, *To loſe all reliſh of life, is to loſe life in effect;* the figure vaniſhes. And this is the nature of the verbal figures. But it is not ſo in figures of ſentences: they continue the ſame, whatever alterations are made in the words. An orator ſometimes thinks it proper to change the form of his diſcourſe, and addreſs himſelf to his audience, or an abſent perſon, or elſe perhaps to introduce ſome other perſon as ſpeaking to them whoſe words may be ſuppoſed to carry greater weight and authority with them than his own. The former of theſe is called *apoſtrophe*, and the latter *proſopœia* or *imagery;* which require no certain words or order of expreſſion.

Art. I. Verbal Figures.

[67] Verbal figures diſtinguiſhed into three ſorts; with their various ſubdiviſions.

Theſe may be diſtinguiſhed into three ſorts, as they conſiſt in a *deficiency* of words, a *redundancy*, or a *repetition*.

I. Of the firſt ſort are *ellipſis* and *aſyndeton*.

Ellipſis, is when one or more words are wanting in a ſentence to complete the conſtruction, and fully expreſs the ſenſe. This figure is often uſed in proverbial ſpeeches: as when we ſay, *Many men, many minds;* that is, *have many minds;* and, *The more danger, the more honour;* that is, *gains more honour*. But where more is intended by ſuch expreſſions than mere brevity, and eſpecially when they are the effect of ſome paſſion, the figure receives another name, and is called *apoſiopeſis*, which is placed among the figures of ſentences, where we ſhall conſider it.

Aſyndeton, is when the particles that connect the members of a ſentence one with another are left out, to repreſent either the celerity of an action, or the haſte and eagerneſs of the ſpeaker. Thus Cæſar expreſſes his ſpeedy conqueſt of Pharnaces: *I came, I ſaw, I conquered*. If he had inſerted the copulatives, and ſaid, *I came, and I ſaw, and I conquered*, it would have retarded the expreſſion, and not given ſo full and juſt an idea of the ſwiftneſs of the action. In the laſt article we took notice of the vehement and impetuous manner in which Cicero attacked Catiline in his firſt oration, where his deſign was to fire the minds of the ſenate againſt him, and oblige him to leave the city, both which points he gained by that ſpeech. The next day, therefore, when Catiline was gone, he calls together the body of the citizens, and, makes a ſpeech to them, which in a ſort of rapture or tranſport of mind he thus begins, by acquainting them with the departure of Catiline, *He is gone, departed, eſcaped, broke out;* intimating at the ſame time both the exceſſive rage in which Catiline left Rome, and the great pleaſure with which he was himſelf affected on that account. This conciſe way of ſpeaking adds likewiſe a conſiderable emphaſis to an expreſſion, and by bringing the ſeveral parts of a thing nearer together affects the mind with greater force. Thus Cicero ſets Cato's character in a very ſtrong and beautiful light by the uſe of this figure. "Nature itſelf (ſays he) has made you a great and excellent man for integrity, gravity, temperance, magnanimity, juſtice, in a word, for all virtues."

II. The ſecond ſort of verbal figures is contrary to theſe, and conſiſts in a redundancy or multiplicity of words; which are likewiſe two, *pleonaſmus* and *polyſyndeton*.

When we uſe more words than are neceſſary to expreſs a thing, it is called *pleonaſmus*. This is done ſometimes for greater emphaſis, as when we ſay, *Where in the world is he?* At other times it is deſigned to aſcertain the truth of what is ſaid: So the ſervant in Terence, when the truth of what he had related was called in queſtion, replies, *It is certainly ſo; I ſaw it with theſe very eyes*.

When the ſeveral parts of a ſentence are united by proper particles, it is called *polyſyndeton*. This adds a weight and gravity to an expreſſion, and makes what is ſaid to appear with an air of ſolemnity; and by retarding the courſe of the ſentence, gives the mind an opportunity to conſider and reflect upon every part diſtinctly. We often meet with this figure in Demoſthenes, which very well ſuits with the gravity of his ſtyle. So he encourages the Athenians to proſecute the war againſt King Philip of Macedon, from this conſideration, that now "they had ſhips and men, and money, and ſtores, and all other things which might contribute to the ſtrength of the city, in greater number and plenty than in former times." Every article here has its weight, and carries in it a proper motive to animate them to the war. But if you remove the copulatives, the ſentence will loſe much of its force.

III. The third kind of verbal figures conſiſts in a *repetition*. And either the ſame word in ſound or ſenſe, is repeated; or one of a like ſound, or ſignification, or both.

Of the former ſort there are ten, called *antanaclaſis*, *ploce*, *epizeuxis*, *climax*, *anaphora*, *epiſtrophe*, *ſymploce*, *epanalepſis*, *anadiploſis*, and *epanodos*. The two firſt of theſe agree in ſound, but differ in ſenſe; the eight following agree in both.

When the ſame word in ſound but not in ſenſe is repeated, it is called *antanaclaſis*. This figure ſometimes carries a poignancy in it; and when it appears natural and eaſy, diſcovers a ready turn of thought. As when a ſon, to clear himſelf of ſuſpicion, aſſured his father *he did not wait for his death;* his father replied, *But I deſire you would wait for it*. Here the word *wait* is taken in two different ſenſes. It is likewiſe uſed on ſerious occaſions, as in grave and moral precepts, which are apt to affect the mind with greater pleaſure when delivered in an agreeable dreſs. As this: *Care for thoſe things in your youth, which in old age may free you from care:* Where the word *care* in the former place ſignifies to *provide*, and in the latter *anxiety of mind*. And even our Saviour himſelf once uſes this figure, when he ſays to one of his diſciples, who

who desired to be dismissed from attending him that he might go and bury his father; *Follow me, and let the dead bury their dead:* Where *dead* in one place denotes a *natural death*, and in the other a *moral* or *spiritual death*.

Sometimes the name of some person or thing is repeated again, to denote some particular character or property designed to be expressed by it; and then it is called *ploce*. Thus Cicero says, *Young Cato wants experience, but yet he is Cato;* meaning he had the steady temper of the family. And so in the proverbial expression, *An ape is an ape, dress him ever so fine.*

68 When a word is repeated again with vehemence in the same sense, it is called *epizeuxis*. This figure shows the earnestness of the speaker, and his great concern of mind about what he says; and therefore has a natural tendency to excite the attention of the audience. It is suited to express anger, surprise, sorrow, and several other passions. As when Cicero would express his indignation against Antony for having been the chief instrument in bringing on the civil war, he says to him: *You, you, Antony pushed Cæsar upon the civil war.* And thus he tells Catiline in his first invective against him: *You live; and live, not to lay aside, but to pursue, your wicked design.* And when our Saviour would express his great concern and sorrow for the wickedness of the Jews, he does it in this pathetic manner: *O Jerusalem, Jerusalem, who killest the prophets.*

69 *Climax* is a beautiful kind of repetition, when the word, which ends the first member of a period, begins the second, and so through each member, till the whole is finished. There is a great deal of strength as well as beauty in this figure, where the several steps rise naturally, and are closely connected with each other. As in this example: *There is no enjoyment of property without government, no government without a magistrate, no magistrate without obedience, and no obedience where every one acts as he pleases.* But, as Quintilian observes, this figure lies so open, that it is apt to look too much like art; for which reason he advises not to use it often. To prevent this, therefore, orators sometimes disguise it, by not repeating the same word which stood in the former member, but some other equivalent to it. As in the following instance of Cicero for Milo: "Nor did he commit himself only to the people, but also to the senate; nor to the senate only, but likewise to the public forces; nor to these only, but also to his power with whom the senate had entrusted the whole commonwealth.

70 When several sentences, or members of a sentence, begin with the same word, it is called *anaphora*. This is a lively and elegant figure, and serves very much to engage the attention. For by the frequent return of the same word the mind of the hearer is held in an agreeable suspense, till the whole is finished. "You do nothing (says Cicero to Catiline), you attempt nothing, you think nothing, but what I not only hear, but also see, and plainly perceive." It is frequently used by way of question; which renders it not only beautiful, but likewise strong and nervous. As at the beginning of the same speech: "Does neither the night-guard of the palace, nor the city-watch, nor the people's fear, nor the agreement of all good men, nor the meeting of the senate in this fortified place, nor the countenances and looks of this assembly, at all move you?" And in another of his orations: "What is so popular as peace, which seems to afford a pleasure, not only to beings endowed with sense, but even to inanimate nature? What is so popular as liberty, which even beasts as well as men seem to covet and prefer above all things? What is so popular as ease and leisure, for the enjoyment of which you and your ancestors have undergone the greatest labours?"

Epistrophe is contrary to the former, and makes the repetition at the end of each member or sentence. As 71
thus; "*Since concord was lost; friendship was lost, fidelity was lost, liberty was lost; all was lost.* And Cicero, in the charge which he brings against Mark Antony before the senate, makes use of this figure, when he says, "Do you lament the destruction of three Roman armies? the author of that destruction was Antony. Do you bewail the loss of most eminent citizens? They have been taken from you by Antony. Is the authority of this order weakened? It is weakened by Antony."

Symploce takes in both these last figures. As in that 72
of Cicero: "You would pardon and acquit him, whom the senate hath condemned, whom the people of Rome have condemned, whom all mankind have condemned." Here the several members both begin and end with the same word. We have a beautiful instance of it in St Paul, when he says, "Are they Hebrews? so am I. Are they Israelites? so am I. Are they the seed of Abraham? so am I.

When a sentence concludes with the word with which 73
it began, it is called *epanalepsis*. As in that expression of Plautus, "Virtue contains all things, he wants no good thing who has virtue." The figure is the same, but the principle not so honest, in the advice which we find given by the miser in Horace, when he says, "Get money, if you can, honestly; but however, get money." This figure adds a force to an expression, when the principal thing designed to be conveyed is thus repeated, by leaving it last upon the mind. And it heightens the beauty of it, when the sentence has an agreeable turn arising from two opposite parts. As in Cicero's compliment to Cæsar: "We have seen your victory terminated by the war; your drawn sword in the city we have not seen." Hermogenes calls this a *circle*, because the sentence returns again to the same word, as that geometrical figure is formed by the orbicular motion of a line to the same point.

When the following sentence begins with the same 74
word with which the former concluded, it is termed *anadiplosis*. As in the following instance: *Let us think no price too great for truth; truth cannot be bought too dear.* So in that passage of St John: *He came to his own, and his own received him not.* This figure generally suits best with grave and solemn discourses.

Epanodos is the inversion of a sentence, or repeat- 75
ing it backwards, so that it takes in the two last figures; for it both begins and ends with the same word, and the same word is likewise repeated in the middle. This turn of expression has a beauty in it, and shows a readiness of thought. We have the following example of

Elocution.

of it in Minutius Felix, where he is expoſing the folly of the Egyptian ſuperſtition. "Iſis (ſays he), with Cynocephalus and her prieſts, laments, bemoans, and ſeeks her loſt ſon; her attendants beat their breaſts, and imitate the grief of the unhappy mother; in a little time the ſon is found, upon which they all rejoice. Nor do they ceaſe every year to loſe what they find, or to find what they loſe. And is it not ridiculous to lament what you worſhip, or to worſhip what you lament?" It ſerves likewiſe to illuſtrate and enforce the ſenſe, by ſetting it in two oppoſite views. As in that expreſſion of the prophet: "Wo unto them who call good evil, and evil good; who put darkneſs for light, and light for darkneſs!"

Thoſe figures which conſiſt in a repetition of words of a like ſound or ſignification, or both, are four; *paronomaſia*, *homoioptoton*, *ſynonymia*, and *derivatio*; the two firſt of which reſpect words that are ſimilar in ſound only, the third in ſenſe, and the laſt in both.

76 When two words very near in ſound, but different in ſenſe, reſpect each other in the ſame ſentence, it is called *paranomaſia*. As when we ſay, *After a feaſt comes a faſt*; and, *A friend in need is a friend indeed*. We uſually call it a *pun*, which when new, and appoſitely uſed, paſſes for wit, and ſerves to enliven converſation. Nor is it wholly to be excluded from grave and ſerious diſcourſes: for a witty jeſt has many times had a better effect than a ſolid argument, and prevailed with thoſe who could not be moved by cloſe reaſoning. And therefore Cicero and the beſt ſpeakers have ſometimes recourſe to it upon weighty and ſolemn occaſions, as will be ſhown hereafter in its proper place.

77 When the ſeveral parts of a ſentence end with the ſame caſe, or tenſe of a like ſound, this alſo is conſidered as a figure, and named *homoioptoton*. As thus: *No marvel though wiſdom complain that ſhe is either wilfully deſpiſed, or careleſsly neglected: either openly ſcorned, or ſecretly abhorred.* This figure is eſteemed moſt beautiful when the parts are all of the ſame length, or pretty near it; as it adds to the harmony of the period, and renders the cadency of the ſeveral members more muſical from the juſt proportion between them. The Greek rhetoricians were much addicted to this figure, and Iſocrates is particularly celebrated for it. But ſome of the beſt orators ſeem to have induſtriouſly avoided it, as carrying in it too much the appearance of art. And it is remarkable, that this figure appears nowhere ſo much in all the works of Demoſthenes, as in an oration which he did not ſpeak himſelf, but wrote for his friend Diodorus, a man of that taſte, who was to pronounce it as his own.

78 The next figure above-mentioned is *ſynonymia*. Now ſtrictly ſpeaking, ſynonymous words are thoſe which have exactly the ſame ſenſe. But there being few ſuch, the uſe of the term is ſo far extended as to comprehend words of a near affinity in their ſignification, which in diſcourſe are frequently put for one another. So, *to deſire*, and *intreat*, are ſometimes uſed as equivalent terms; whereas *to deſire* is no more than to wiſh for a thing, and *to intreat* is to expreſs that inclination in words. In like manner, *eſteem* and *honour* are often taken for ſynonymous words, though they have not preciſely the ſame ſenſe, but one is the uſual conſequence of the other; for eſteem is the good opinion we entertain of a perſon in our mind, and honour the outward expreſſion of that opinion. When two or more ſuch words come together, they conſtitute this figure. As when Cicero, ſpeaking of Piſo, ſays, "His whole countenance, which is the tacit language of the mind, has drawn men into a miſtake, and deceived, cheated, impoſed on thoſe who did not know him." This figure ſometimes adds force to an expreſſion, by enlivening the idea; and it often promotes the harmony and juſt cadency of a ſentence, which otherwiſe would drop too ſoon, and diſappoint the ear.

When ſuch words as ſpring from the ſame root, as 79
juſtice, *juſt*, *injuſtice*, *unjuſt*, and the like, come together in the ſame ſentence, they make the figure called *derivatio*. Cicero, obſerving the vanity of the philoſophers who affected praiſe, at the ſame time that they decried it, uſes this figure, when he ſays of them, "The philoſophers ſet their names to thoſe very books which they write for the contempt of glory; and are deſirous to be honoured and applauded, even for what they ſay in contempt of honour and applauſe." This figure receives an additional beauty when repeated, eſpecially in two oppoſite members; as, *He wiſhed rather to die a preſent death, than to live a miſerable life.*

Art. II. Figures *of* Sentences.

Of theſe, ſome are principally adapted for reaſoning, and others to move the paſſions.

80 Of figures of ſentences; ſome are for reaſoning and ſome for moving the paſſions.

I. *Thoſe ſuited for proof*, Which are ſix: *Prolepſis*, *hypobole*, *anacoinoſis*, *epitrope*, *parabole*, and *antitheſis*.

Prolepſis, or *anticipation*, is ſo called, when the orator firſt ſtarts an objection, which he foreſees may be made either againſt his conduct or cauſe, and then anſwers it. Its uſe is to foreſtal an adverſary, and prevent his exceptions, which cannot afterwards be introduced with ſo good a grace. Though it has likewiſe a farther advantage, as it ſerves to conciliate the audience, while the ſpeaker appears deſirous to repreſent matters fairly, and not to conceal any objection which may be made againſt him. The occaſions of this figure are various; and the manner of introducing it very different. Sometimes the orator thinks it neceſſary to begin with it, in order to juſtify his conduct, and remove any exceptions which may be made againſt his deſign. Cicero, for ſeveral years together, after he firſt began to plead, had always been for the defendant in criminal caſes. And therefore, when he was prevailed with to undertake the accuſation of Verres, he begins his oration with this apology for himſelf: "If any one preſent ſhould wonder, that when for ſeveral years paſt I have ſo conducted myſelf as to defend many and accuſe none, I now on a ſudden alter my cuſtom, and undertake an accuſation: when he ſhall have heard the occaſion and reaſon of my deſign, he will both approve of it, and think no perſon ſo proper to manage this affair as myſelf." And then he proceeds to give an account of the reaſons which moved him to engage in it. At other times the objection is admitted as an exception to what has been ſaid, but not ſo as to affect it in general. Thus, when Cicero has repreſented the advantages of literature and the polite arts, he ſtarts this objection to what himſelf had ſaid, "But ſome one will aſk, whether thoſe great men, the memory of whoſe glorious actions is delivered down to poſterity, were acquainted with that ſort of learning

I so applaud?" To which he replies, "Indeed this can scarce be said of them all. However, the answer is easy. I have known several persons of excellent abilities, who, without learning, by the force of an extraordinary genius have been men of great virtue and solidity. Nay, I will add, that nature without learning, has oftener produced these qualifications, than learning without a genius. But yet it must still be owned, that where both these meet, they form something very excellent and singular." Again, at other times, the orator artfully represents the objection as something considerable and important, to give the greater weight to his answer when he has confuted it. Cicero, in his celebrated oration for the Manilian law, could not omit to take notice, that Lucullus had already gained several very considerable advantages over Mithridates. And therefore, having before described the war as very great and dangerous, apprehending these two accounts might appear somewhat inconsistent, and be liable to an objection, he puts it thus artfully himself: "But now, after what I have said of Lucullus, it may probably be asked, How then can the war be so great? be pleased to hear, for there seems to be very just reason for this question." And then he proceeds to show, from the power of King Mithridates at that time, his great abilities, long experience in military affairs, and fresh alliances, that the war was yet very great and dangerous. But sometimes, when the orator is sensible that what he has advanced lies open to an objection, he omits to make it in express terms; and yet proceeds to vindicate what he had said, as if it had been made. Thus, when Cicero had charged Verres with having plundered the inhabitants of Sicily of all their plate, jewels, and other valuable moveables, which he thought worth while to carry away; as the audience might imagine this to be scarce credible, he takes it for granted they thought so, and therefore immediately adds, "As strange as this is, I affirm it positively, without any intention to aggravate the crime." And so he goes on to the proof of his assertion. But this figure is likewise made use of to guard against some objection, which the speaker apprehends may be made against what he designs to say. And thus Cicero uses it in his oration for Sextius. "My province (says he), as I speak last, seems to call for affection to my friend, rather than his defence; complaint, rather than eloquence; expressions of grief, rather than art. And therefore, if I shall express myself with more warmth, or greater freedom, than those who have spoke before me, I hope you will grant me all that liberty of speech which you judge reasonable to be allowed to an affectionate sorrow and just resentment." This figure requires great prudence and discretion in the management of it. The speaker must consider well the temper, bias, and other circumstances of his hearers, in order to form a right judgement what parts of his discourse may be most liable to exception. For to object such things, which the hearers would never have thought of themselves, is to give himself a needless trouble; and to start such difficulties, which he cannot afterwards fairly remove, will expose both himself and his cause. But as nothing gives an audience greater pleasure and satisfaction, than to have their scruples fully answered as they rise in their thoughts; so, on the contrary, be a discourse otherwise ever so entertaining and agreeable, if there be any doubt left upon the minds of the hearers, it gives them a pain that continues with them till it be removed.

81 The figure *hypobole* or *subjection*, is not much unlike the former; and is, when several things are mentioned that seem to make for the contrary side, and each of them refuted in order. It consists of three parts, when complete; a proposition, an enumeration of particulars with their answers, and a conclusion.—Thus Cicero, upon his return from banishment, vindicates his conduct in withdrawing so quietly, and not opposing the faction that ejected him. "My departure (says he) is objected to me; which charge I cannot answer without commending myself. For what must I say? That I fled from a consciousness of guilt? But what is charged upon me as a crime, was so far from being a fault, that it is the most glorious action since the memory of man, (he means his punishing the associates of Catiline.) That I feared being called to an account by the people? That was never talked of; and if it had been done, I should have come off with double honour. That I wanted the support of good and honest men? That is false. That I was afraid of death? That is a calumny. I must therefore say, what I would not, unless compelled to it, that I withdrew to preserve the city." When the objections are put by way of question, as in the example here given, they add a briskness and poignancy to the figure. All the parts of it are not constantly expressed. For thus Cicero in his defence of Plancius introduces his adversary objecting, and himself answering, "The people judged ill, but they did judge; they should not have done it, but they had a power; I cannot submit to it, but many very great and wise men have."—Both the proposition and conclusion are here omitted.

82 The next figure in order is *anacoinosis*, or *communication*; by which the speaker deliberates either with the judges, the hearers, or the adversary himself. Thus Cicero addresses the judges in his accusation of Verres: "Now I desire your opinion what you think I ought to do. And I know your advice will be, though you do not declare it, what appears to me necessary to be done." In another place we find him reasoning in this manner with the adverse party: "What could you have done in such a case, and at such a time: when to have sat still, or withdrawn, would have been cowardice? When the wickedness and fury of Saturnius the tribune had called you into the capitol; and the consuls, to defend the safety and liberty of your country; whose authority, whose voice, which party would you have followed, and whose command would you have chosen to obey?" This figure carries in it an air of modesty and condescension, when the speaker seems unwilling to determine in his own cause, but refers it to the opinion of others. It likewise shows a persuasion of the equity of his cause, that he can leave it to their arbitration; and serves very much to conciliate their minds, while he joins them, as it were with himself, and makes them of his party. And when the appeal is made to the adverse party, it is of considerable advantage, either to extort a confession, or at least to silence him. And therefore the sacred writers sometimes very beautifully introduce God himself thus expostulating with mankind; as the prophet Malachi,

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Malachi, *A son honoureth his father, and a servant his master. If then I be a father, where is mine honour? and if I be a master, where is my fear?*

83 Another figure that comes under this head, is *epitrope* or *concession;* which grants one thing, to obtain another more advantageous. It is either real or feigned; and either the whole of a thing, or a part only, is granted. We shall consider each of these separately, and illustrate them with proper examples. Nothing more confounds an adversary, than to grant him his whole argument; and at the same time either to show that it is nothing to the purpose, or to offer something else which may invalidate it. *I allow*, says the claimant by will against the heir at law, *that no body was more nearly related to the deceased than you; that he was under some obligations to you; that you were in the army together: but what is all this to the will?* And thus Cicero in his defence of Ligarius, who was accused by Tubero for having joined with Pompey in the civil war between him and Cæsar: "You have, Tubero, what an accuser would most desire, the accused person confessing the charge; but so as to affirm, that he was of the same party with you and your excellent father. Therefore own first that it was a crime in yourself, before you charge it as such upon Ligarius." Sometimes the orator gives up some particular point that would well admit of a dispute, to gain something more considerable, which he thinks cannot fairly be denied him. In the affair of Roscius, where the proof depended upon circumstances, Cicero, who defended him, inquires what reason could be alledged for his committing so black a crime, as to kill his father. And after he has shown there was no probable reason to be assigned for it, he adds, "Well, since you can offer no reason, although this might be sufficient for me, yet I will recede from my right; and upon the assurance I have of his innocence, I will grant you in this cause what I would not in another. I do not therefore insist upon your telling me why he killed his father, but ask how he did it?" This appearance of candour and ingenuity in such concessions removes the suspicion of art, and gives greater credit to what is denied. We have an example of a feigned or ironical concession in Cicero's defence of Flaccus: where, interceding for him on the account of his former good services in the time of Catiline's conspiracy, he says in a way of irony, If such things are to be overlooked, "let us appease the ghosts of Lentulus and Cethegus; let us recal those who are in exile; and let us be punished for our too great affection and love for our country." By this artful insinuation, the orator, after he has used all his arguments to persuade his hearers, does as it were set them at liberty, and leave them to their own election; it being the nature of man to adhere more stedfastly to what is not violently imposed, but referred to his own free and deliberative choice. And to these feigned concessions may be referred such ways of reasoning, by which the orator both justifies a charge brought against him upon the supposition of its being true, and also proves that the charge itself is false. Thus Cicero, in his defence of Milo, represents the taking off Clodius, with which Milo was accused, as a glorious action; after he has shown that Milo's servants did it without the knowledge of their master.

84 *Parabole* or *similitude*, illustrates a thing by comparing it with some other, to which it bears a resemblance. Similitudes are indeed generally but weak arguments, though often beautiful and fine ornaments. And where the design of them is not so much to prove what is doubtful, as to set things in a clear and agreeable light, they come properly under the notion of figures. They are of two sorts; simple and compound. Those are called *simple*, in which one thing only is likened or compared to another, in this manner: *As swallows appear in summer, but in winter retreat; so false friends show themselves in prosperity, but all fly away when adversity approaches.* Compound similitudes are such, wherein one thing is likened or compared to several others; as thus: *What light is to the world, physic to the sick, water to the thirsty, and rest to the weary; that is knowledge to the mind.* The more exact the agreement is between the things thus compared, they give the greater beauty and grace to the figure.

Antithesis, or *opposition*, by which things contrary or different are compared, to render them more evident. 85
Thus Cicero says, "The Roman people hate private luxury, but love public grandeur." This is a very florid figure; and suited no less for amplification than proof. As in the following instance of Cicero, where, speaking of Pompey, he says, "He waged more wars than others had read; conquered more provinces than others had governed; and had been trained up from his youth to the art of war, not by the precepts of others, but by his own commands; not by miscarriages in the field, but by victories; not by campaigns, but triumphs." It is esteemed a beauty in this figure when any of the members are inverted, which some call *antimetathesis*. As where Cicero, opposing the conduct of Verres when governor of Sicily, to that of Marcellus who took Syracuse the capital city of that island, says, "Compare this peace with that war, the arrival of this governor with the victory of that general, his profligate troops with the invincible army of the other, the luxury of the former with the temperance of the latter; you will say, that Syracuse was founded by him who took it, and taken by him who held it when founded." To this figure may also be referred *oxymoron*, or *seeming contradiction;* that is, when the parts of a sentence disagree in sound, but are consistent in sense. As when Ovid says of Althea, that *she was impiously pious.* And so Cato used to say of Scipio Africanus, that "he was never less at leisure, than when he was at leisure; nor less alone, than when alone:" By which he meant, as Cicero tells us, that "Scipio was wont to think of business in his retirement, and in his solitude to converse with himself." This is a strong and bold figure, which awakens the mind, and affords it an agreeable pleasure to find upon reflection, that what at first seemed contradictory, is not only consistent with good sense, but very beautiful.—The celebrated Dr Blair, whom we have more than once quoted in this article, has these observations on antithesis, or the contrast of two objects. "Contrast has always this effect, to make each of the contrasted objects appear in the stronger light. White, for instance, never appears so bright as when it is opposed to black, and when both are viewed together. Antithesis, therefore, may, on many occasions be employed to advantage, in order to strengthen the impression which we intend that any object should make. In order to render an antithesis more complete, it is always

always of advantage that the words and members of the sentence, expressing the contrasted objects, be similarly constructed, and made to correspond to each other. This leads us to remark the contrast more, by setting the things which we oppose more clearly over against each other; in the same manner as when we contrast a black and a white object, in order to perceive the full difference of their colour, we would choose to have both objects of the same bulk, and placed in the same light. Their resemblance to each other, in certain circumstances, makes their disagreement in others more palpable. At the same time I must observe, that the frequent use of antithesis, especially where the opposition in the words is nice and quaint, is apt to render the style disagreeable. A maxim, or moral saying, properly enough receives this form; both because it is supposed to be the fruit of meditation, and because it is designed to be engraven on the memory, which recals it more easily by the help of such contrasted expressions. But where a string of such sentences succeed each other, where this becomes an author's favourite and prevailing manner of expressing himself, his style is faulty; and it is upon this account Seneca has been often and justly censured. Such a style appears too studied and laboured; it gives us the impression of an author attending more to his manner of saying things, than to the things themselves which he says." There is still another kind of antithesis, which consists in surprising us by the unexpected contrasts of things which it brings together; but it is such as is wholly beneath the dignity of an orator, or of grave compositions of any sort, and is fit only for pieces of professed wit and humour, calculated only to excite laughter or create ridicule.

86 The second kind of figures of sentences.

II. *Those suited to move the passions.* Which are 13; namely, *epanorthosis*, *paralepsis*, *parrhesia*, *aparithmesis*, *exergasia*, *hypotyposis*, *aporia*, *posiopesis*, *erotesis*, *ecphonesis*, *epiphonema*, *apostrophe*, and *prosopopeia*.

Epanorthosis, or *correction*, is a figure, by which the speaker either recals or amends what he had last said. It is used different ways. For sometimes one or more words are recalled by him, and others subjoined in their room; at other times, without recalling what has been said, something else is substituted as more suitable. This is a very extensive figure, and made use of in addressing different passions. We have an instance of it in Terence's *Self-tormentor*, where the old man, whose extraordinary concern for the absence of his son gave occasion to the name of the play, thus bewails his condition to his neighbour. "I have an only son, Chremes. Alas! did I say that I have: I had indeed; but it is now uncertain whether I have or not." Here, to aggravate his misfortune, he recals a pleasing word, and substitutes another more affecting in its place. And Cicero, in his defence of Milo, speaking to the judges concerning Clodius, says, "Are you only ignorant what laws, if they may be called laws, and not rather torches and plagues of the state, he was about to impose and force upon us?" Again, in his defence of Plancius, he says, "What greater blow could those judges, if they are to be called judges, and not parricides of their country, have given to the state, than when they banished him, who when prætor freed the republic from a neighbouring war, and when consul from a civil one?" He is speaking there of Opimius. But in commending the moderation of Lucius Mummius, who did not enrich himself, but his country, by demolishing the wealthy city of Corinth, he thus recals his whole expression, and by giving it a new turn, heightens the compliment he designed him: "He chose rather (says he) to adorn Italy than his own house; though by adorning Italy his house seems to have received the greatest ornament." And sometimes the correction is made by substituting something contrary to what had been said before; as in the following passage of Cicero: "Cæsar (meaning Augustus), though but a youth, by an incredible and surprising resolution and courage, when Antony was most enraged, and we dreaded his cruel and pernicious return from Brundusium, at a time when we neither asked, nor expected, nor desired it (because it was thought impossible), raised a very powerful army of invincible veterans; to effect which he threw away his whole estate: Though I have used an improper word; for he did not throw it away, but employed it for the safety of the government." At other times, as has been said, the correction is made by adding a more suitable word, without any repetition of the former. Thus Cicero, after he has inveighed against the crimes of Verres, breaks out into this pathetic exclamation: *O the clemency, or rather wonderful and singular patience, of the Roman people!* He did not think the word *clemency* strong enough, and therefore adds *patience*, as better answering his design. The sudden and unexpected turn of this figure gives a surprise to the mind, and by that means renders it the more pathetic.

Paralepsis, or *omission*, is another of these figures, 87
when the speaker pretends to omit, or pass by, what at the same time he declares. It is used either in praise or dispraise. Thus Cicero, in his defence of Sextius, introduces his character in this manner, with a design to recommend him to the favour of the court: "I might say many things of his liberality, kindness to his domestics, his command in the army, and moderation during his office in the province: but the honour of the state presents itself to my view; and calling me to it, advises me to omit these lesser matters." But in his oration to the senate against Rullus the tribune, who had proposed a law to sell the public lands, he makes use of this figure to represent the pernicious effects of such a law, particularly with respect to the lands in Italy. "I do not complain (says he) of the diminution of our revenues, and the woeful effects of this loss and damage. I omit what may give every one occasion for a very grievous and just complaint, that we could not preserve the principal estate of the public, the finest possession of the Roman people, the fund of our provisions, the granary of our wants, a revenue entrusted with the state; but that we must give up those lands to Rullus, which, after the power of Sylla, and the largesses of the Gracchi, are yet left us. I do not say, this is now the only revenue of the state, which continues when others cease, is an ornament in peace, fails us not in war, supports the army, and does not fear an enemy. I pass over all these things, and reserve them for my discourse to the people, and only speak at present of the danger of our peace and liberties." His view here was to raise the indignation of the senate against Rullus, and excite them to oppose the law. There is a beautiful instance of this figure in St Paul's epistle to Philemon, where, after he has earnestly intreated him to receive again Onesimus his servant, who had run from him, and promised that if he

he had wronged him, or owed him any thing, he would repay it, he adds, *That I may not say, you owe even yourself to me.* Nothing could be a stronger motive to soften his displeasure against his servant, from a sense of gratitude to the apostle. Hermogenes has observed, that the design of this figure is to possess the minds of the audience with more than the words express, and that it is principally made use of on three occasions: either when things are small, but yet necessary to be mentioned; or well known, and need not be enlarged on; or ungrateful, and therefore should be introduced with caution, and not set in too strong a light.

88 The next figure above-mentioned was *Parrhesia*, or *reprehension*: Not that whenever a person admonishes or reproves another it is to be esteemed a figure; but when it is done with art and address, and in such circumstances as render it difficult not to displease.—The orator therefore sometimes prepares his hearers for this by commending them first, urging the necessity of it, representing his great concern for them as his motive, or joining himself with them. Thus Cicero charges the senate with the death of Servius Sulpicius, for sending him to Mark Antony, under a very ill state of health. And his design in it was to bring them more readily into a motion he was about to make, that both a statue and a sepulchral monument might be erected to his memory at the public expence. "You (says he), it is a very severe expression, but I cannot help saying it; you, I say, have deprived Servius Sulpicius of his life. It was not from cruelty indeed (for what is there with which this assembly is less chargeable?), but when his distemper pleaded his excuse more than his words, from the hopes you conceived that there was nothing which his authority and wisdom might not be able to effect, you vehemently opposed his excuse, and obliged him, who always had the greatest regard for your commands, to recede from his resolution." Sometimes, indeed, the orator assumes an air of reproof, with a view only to pass a compliment with a better grace. As Cicero in his address to Cæsar, when he says, "I hear that excellent and wise saying from you with concern, That you have lived long enough, either for the purposes of nature, or glory: for nature perhaps, if you think so: and, if you please, for glory: but, what is principally to be regarded, not for your country." It adds both a beauty and force to this figure, when it is expressed in a way of comparison. As in the following instance of Cicero: "But since my discourse leads me to this, consider how you ought to be affected for the dignity and glory of your empire. Your ancestors often engaged in war to redress the injuries of their merchants or sailors: how ought you then to resent it, that so many thousand Roman citizens were murdered by one message, and at one time? Your forefathers destroyed Corinth, the principal city in Greece, for the haughty treatment of their ambassadors; and will you suffer that king to go unpunished, who has put to death a Roman legate, of consular dignity, in the most ignominious as well as most cruel manner? See, lest, as it was their honour to leave you the glory of so great an empire, it should prove your disgrace not to be able to maintain and defend what you have received from them." By this figure an address is made to the more tender passions, modesty, shame, and emulation, the attendants of an ingenuous temper, which is soonest touched, and most affected, by a just reproof.

Another of these pathetic figures is *Aparithmesis*, or *enumeration*, when that, which might be expressed in 89
general by a few words, is branched out into several particulars, to enlarge the idea, and render it the more affecting. Cicero, in pleading for the Manilian law, where his design is to conciliate the love and esteem of the people to Pompey, thus enlarges upon his character: "Now, what language can equal the virtue of Cneius Pompey? What can be said either worthy of him, or new to you, or which every one has not heard? For those are not the only virtues of a general which are commonly thought so; labour in affairs, courage in dangers, industry in acting, dispatch in performing, design in contriving; which are greater in him than in all other generals we have ever seen or heard of." And so likewise, when he endeavours to dispossess Pompey of the apprehension that Milo designed to assassinate him: "If (says he) you fear Milo; if you imagine that either formerly, or at present, any ill design has been formed by him against your life; if the soldiers raised through Italy (as some of your officers give out), if these arms, if these cohorts in the Capitol, if the centries, if the watch, if the guards which defend your person and house, are armed to prevent any attempt of Milo, and all of them appointed, prepared, and stationed on his account; he must be thought a person of great power, and incredible resolution, above the reach and capacity of a single man, that the most consummate general, and the whole republic are in arms against him only. But who does not perceive, that all the disordered and sinking parts of the state are committed to you, to rectify and support them by these forces?" This might have been said in a few words, that such vast preparations could never be intended for so low a purpose. But the orator's view was to expose that groundless report, and shame it out of countenance. And soon after he endeavours to raise compassion for Milo under those prejudices by the same figure: "See how various and changeable is the state of human life, how unsteady and voluble is fortune, what infidelity in friends, what disguises suited to the times, what flights, what fears, even of the nearest acquaintance, at the approach of dangers." Had no address to the passions been designed here, fewer of these reflections might have been sufficient. The use of this figure in amplification is very evident from the nature of it, which consists in unfolding of things, and by that means enlarging the conception of them.

Exergasia, or *exposition*, has an affinity with the former figure: but it differs from it in this, that it consists 90
of several equivalent expressions, or nearly such, in order to represent the same thing in a stronger manner; whereas the other enlarges the idea by an enumeration of different particulars. So that this figure has a near relation to synonymia, of which we have treated before under *Verbal Figures*. We have an instance of it in Cicero's defence of Sextius, where he says, "Those who at any time have incited the populace to sedition, or blinded the minds of the ignorant by corruption, or traduced brave and excellent men, and such as deserved well of the public, have with us always been esteemed vain, bold, bad, and pernicious citizens. But those who repressed the attempts and endeavours of such as, by their authority, integrity, constancy, resolution, and prudence, withstood their insolence, have been always accounted men of solidity, the chiefs, the leaders, and supporters

ſupporters of our dignity and government." Nothing more is intended by this paſſage, but to ſet the oppoſite characters of factious perſons and true patriots in the ſtrongeſt light, with a view to recommend the one, and create a juſt hatred and deteſtation of the other. So elſewhere he repreſents the juſtice of ſelf-defence in no leſs different terms: "If reaſon (ſays he) preſcribes this to the learned, and neceſſity to barbarians, cuſtom to nations, and nature itſelf to brutes, always to ward off all manner of violence, by all poſſible ways, from their body, from their head, from their life; you cannot judge this to be a criminal and wicked action, without judging at the ſame time that all perſons who fall among robbers and aſſaſſins muſt either periſh by their weapons, or your ſentence."—He is addreſſing here to the judges in favour of Milo. The warmth and vehemence of the ſpeaker often runs him into this figure, when he is affected with his ſubject, and thinks no words, no expreſſions, forcible enough to convey his ſentiments; and therefore repeats one after another, as his fancy ſuggeſts them. This flow of expreſſion, under the conduct of a good judgement, is often attended with advantage; as it warms the hearers, and impreſſes their minds, excites their paſſions, and helps them to ſee things in a ſtronger light.

91 *Hypotypoſis*, or *imagery*, is a deſcription of things painted in ſuch ſtrong and bright colours, as may help the imagination of the hearers to conceive of them rather as preſent to their view, than deſcribed in words. It is peculiarly ſuited for drawing characters; and often affords the fineſt ornaments in poetry and hiſtory, as well as oratory. Nor is it leſs moving, but ſuited to ſtrike different paſſions, according to the nature of the ſubject, and artful management of the ſpeaker. Cicero has thus drawn the picture of Catiline, conſiſting of an unaccountable mixture of contrary qualities. "He had (ſays he) the appearance of the greateſt virtues: he made uſe of many ill men to carry on his deſigns, and pretended to be in the intereſt of the beſt men; he had a very engaging behaviour, and did not want induſtry and application; he gave into the greateſt looſeneſs, but was a good ſoldier. Nor do I believe there was ever the like monſter in the world, made of ſuch jarring and repugnant qualities and inclinations. Who at one time was more acceptable to the beſt men, and who more intimate with the worſt? Who was once a better patriot, and who a greater enemy to this ſtate? Who more devoted to pleaſures, who more patient in labours? Who more rapacious, and yet more profuſe? He ſuited himſelf to the humours of all he converſed with: was ſerious with the reſerved, and pleaſant with the jocoſe; grave with the aged, and facetious with the young; bold with the daring, and extravagant with the profligate." Such a character of a man, when accompanied with power and intereſt, muſt render him no leſs the object of fear than deteſtation, which was the deſign of Cicero in this deſcription. And elſewhere, in order to prevail with the ſenate to direct the execution of thoſe conſpirators with Catiline who were then in priſon, he paints the moſt diſmal ſcene of that horrid deſign in the ſtrongeſt colours. "Methinks (ſays he) I ſee this city, the light of the world, and citadel of all nations, ſuddenly falling into one fire; I perceive heaps of miſerable citizens buried in their ruined country; the countenance and fury of Cethegus raging in your ſlaughter, preſents itſelf to my view." This figure is very ſerviceable in amplification, as we have formerly ſhewn in treating upon that ſubject. But no ſmall judgement is required in the management of deſcriptions. Leſſer circumſtances ſhould either be wholly omitted, or but ſlightly touched; and thoſe which are more material drawn in their due proportion. Nature is as much the rule of the orator as of the painter, and what they both propoſe to imitate. And therefore, let a thought be ever ſo pleaſing and beautiful in itſelf, it muſt not be introduced when foreign to the purpoſe, or out of its place, any more than a painter ſhould attempt to alter nature when he propoſes to copy it. This figure requires likewiſe a vigorous and lively genius. For the images in deſcription can riſe no higher than the conception of the ſpeaker, ſince the idea muſt firſt be formed in his own mind before he can convey it to others; and agreeably to the clearneſs with which he conceives it himſelf, he will be able to expreſs it in words.

Aporia, or *doubt*, expreſſes the debate of the mind with itſelf upon a preſſing difficulty. A perſon in ſuch a ſtate is apt to heſitate, or ſtart ſeveral things ſucceſſively, without coming to any fixed reſolution. The uneaſineſs ariſing from ſuch a diſorder of thought is naturally very moving. Of this kind is that of Cicero for Cluentius, when he ſays, "I know not which way to turn myſelf. Shall I deny the ſcandal thrown upon him of bribing the judges? Can I ſay the people were not told of it? that it was not talked of in the court mentioned in the ſenate? Can I remove an opinion ſo deeply and long rooted in the minds of men? It is not in my power. You, judges, muſt ſupport his innocence, and reſcue him from this calamity." Orators ſometimes chooſe to begin their diſcourſe with this figure. A diffidence of mind at firſt is not unbecoming, but graceful. It carries in it an air of modeſty, and tends very much to conciliate the affections of the hearers. Livy gives us a very elegant example of this in a ſpeech of Scipio Africanus to his ſoldiers, when, calling them together after a ſedition, he thus beſpeaks them: "I never thought I ſhould have been at a loſs in what manner to addreſs my army. Not that I have applied myſelf more to words than things; but becauſe I have been accuſtomed to the genius of ſoldiers, having been trained up in the camp almoſt from my childhood. But I am in doubt what or how to ſpeak to you, not knowing what name to give you. Shall I call you *citizens*, who have revolted from your country? *Soldiers*, who have diſowned the authority of your general, and broke your military oath? *Enemies?* I perceive the mien, the aſpect, and habit of citizens; but diſcern the actions, words, deſigns, and diſpoſitions of enemies." 92

Sometimes a paſſion has that effect, not ſo much to render a perſon doubtful what to ſay, as to ſtop him in the midſt of a ſentence, and prevent his expreſſing the whole of what he deſigned; and then it is called *Apoſiopeſis*, or *concealment*. It denotes different paſſions; as anger, which, by reaſon of its heat and vehemence, cauſes perſons to break off abruptly in their diſcourſe. So the old man in Terence, when he was jealous that his ſervant obſtructed his deſigns, uſes this imperfect but threatening expreſſion, *Whom, if I find*. And Neptune, when deſcribed by Virgil as very angry that the winds ſhould preſume to diſturb the ſea without his permiſſion, after he has called them to him to know the reaſon of it, threatens them in this abrupt manner: 93

"Whom I—but firſt I'll lay the ſtorm."

But Cicero, in writing to Atticus, applies it to expreſs grief, where he ſays, "I know nothing of Pompey, and believe he muſt be taken, if he is not got on ſhipboard. O incredible ſwiftneſs! But of our friend—Though I cannot accuſe him without grief, for whom I am in ſo much concern and trouble." And in a letter to Caſſius he uſes it to expreſs fear, when he ſays to him, "Brutus could ſcarce ſupport himſelf at Mutina; if he is ſafe, we have carried the day. But if—heaven avert the omen! all muſt have recourſe to you." His meaning is, "If Brutus ſhould be defeated."

94 The next figure is *eroteſis*, or *interrogation*. But every interrogation or queſtion is not figurative. When we inquire about a thing that is doubtful, in order to be informed, this is no figure, but the natural form of ſuch expreſſions. As if I aſk a perſon, *Where he is going?* or *what he is doing?* But then it becomes figurative when the ſame thing may be expreſſed in a direct manner; but the putting it by way of queſtion gives it a much greater life and ſpirit. As when Cicero ſays, "Catiline, how long will you abuſe our patience? do not you perceive your deſigns are diſcovered?" He might indeed have ſaid, *You abuſe our patience a long while. You muſt be ſenſible your deſigns are diſcovered.* But it is eaſy to perceive how much this latter way of expreſſion falls ſhort of the force and vehemence of the former. And ſo when Medea ſays, *I could ſave; and do you aſk if I can deſtroy?* Had ſhe ſaid, *I could ſave, and I can deſtroy*, the ſentence had been flat, and very unfit to expreſs the rage and fury in which the poet there repreſents her. This figure is ſuited to expreſs moſt paſſions and emotions of the mind, as anger, diſdain, fear, deſire, and others. It ſerves alſo to preſs and bear down an adverſary. Cicero frequently makes this uſe of it. As in his defence of Plancius: "I will make you this offer (ſays he), chooſe any tribe you pleaſe, and ſhow, as you ought, by whom it was bribed; and if you cannot, as I believe you will not undertake it, I will prove how he gained it. Is this a fair conteſt? Will you engage on this foot? I cannot give you fairer play. Why do you diſſemble? Why do you heſitate? I inſiſt upon it, urge you to it, preſs it, require, and even demand it of you." Such a way of puſhing an antagoniſt ſhows the ſpeaker has great confidence in his cauſe; otherwiſe he would never lay himſelf ſo open, if he was not aſſured the other party had nothing to reply. This figure likewiſe diverſifies a diſcourſe, and gives it a beautiful variety, by altering the form of expreſſion, provided it be neither too frequent, nor continued too long at once. And beſides, the warmth and eager manner in which it is expreſſed, enlivens the hearers, and quickens their attention.

95 *Ecphoneſis*, or *exclamation*, is a vehement extenſion of the voice, occaſioned by a commotion of mind, naturally venting itſelf by this figure, which is uſed by Cicero to expreſs a variety of paſſions. It often denotes reſentment or indignation. Thus, after his return from baniſhment, reflecting on thoſe who had occaſioned it, he breaks out into this moving exclamation: "O mournful day to the ſenate, and all good men, calamitous to the ſtate, afflictive to me and my family, but glorious in the view of poſterity!" His deſign was to excite an odium againſt the authors of his exile, when recalled in ſo honourable a manner. And again, in his defence of Cælius: "O the great force of truth; which eaſily ſupports itſelf againſt the wit, craft, ſubtilty, and artful deſigns of men!" He had been juſt ſhowing the abſurdity of the charge againſt Cælius, and now endeavours to expoſe his accuſers to the indignation of the court. At other times it is uſed to expreſs diſdain or contempt. As when ſpeaking of Pompey's houſe, which was bought by Mark Antony, he ſays: "O conſummate impudence! dare you go within that houſe! dare you enter that venerable threſhold, and ſhew your audacious countenance to the tutelar deities which reſide there." Nor is it leſs ſuited to indicate grief, as when he ſays of Milo: "O that happy country, which ſhall receive this man! ungrateful this, if it baniſh him! miſerable if it loſe him!" And ſometimes it ſerves to expreſs admiration: as when, in compliment to Cæſar, he ſays, "O admirable clemency! worthy of the greateſt praiſe, the higheſt encomiums, and moſt laſting monuments!" It has its uſe alſo in ridicule and irony. As in his oration for Balbus, where he derides his accuſer, by ſaying, "O excellent interpreter of the law! maſter of antiquity! corrector and amender of our conſtitution! The ſacred writers ſometimes uſe it by way of intreaty or wiſh. As the royal Pſalmiſt: "O that I had the wings of a dove, that I might fly away, and be at reſt!" And at other times in triumph and exultation, as in that of St Paul: "O death, where is thy ſting! O grave, where is thy victory!" It is frequently joined with the preceding figure *interrogation*; as appears in ſome of the inſtances here brought from Cicero. And it generally follows the repreſentation of the thing which occaſions it. Though ſometimes it is made uſe of to introduce it, and then it ſerves to prepare the mind by exciting its attention. Thus Cicero, in his defence of Cælius, to render the character of Clodia more odious, at whoſe inſtigation he was accuſed, inſinuates that ſhe had before poiſoned her huſband; and to heighten the barbarity of the fact, and make it appear the more ſhocking, he introduces the account of it with this moving exclamation: "O heavens, why do you ſometimes wink at the greateſt crimes of mankind, or delay the puniſhment of them to futurity!"

Epiphonema, or *acclamation*, has a great affinity with the former figure. And it is ſo called, when the ſpeaker, at the concluſion of his argument, makes ſome lively and juſt remark upon what he has been ſaying, to give it the greater force, and render it the more affecting to his hearers. It is not ſo vehement and impetuous as exclamation, being uſually expreſſive of the milder and more gentle paſſions. And the reflection ought not only to contain ſome plain and obvious truth, but likewiſe to ariſe naturally from the diſcourſe which occaſioned it, otherwiſe it loſes its end. When Cicero has ſhown, that recourſe is never to be had to force and violence, but in caſes of the utmoſt neceſſity, he concludes with the following remark: "Thus to think, is prudence; to act, fortitude; both to think and act, perfect and conſummate virtue." And elſewhere, after he has deſcribed a ſingular inſtance of cruelty and breach of friendſhip: "Hence (ſays he) we may learn, that no duties are ſo ſacred and ſolemn which covetouſneſs will not violate." This figure is frequently expreſſed in a way of admiration. As when Cicero has obſerved, that all men are deſirous to live to an advanced age, but uneaſy under it 96

when

when attained, he makes this juſt reflection upon ſuch a conduct: "So great is their inconſtancy, folly, and perverſeneſs!"

97 The next figure in order is *apoſtrophe*, or *addreſs*, when the ſpeaker breaks off from the ſeries of his diſcourſe, and addreſſes himſelf to ſome particular perſon preſent or abſent, living or dead; or to inanimate nature, as endowed with ſenſe and reaſon. By this means he has an opportunity of ſaying many things with greater freedom than perhaps would be conſiſtent with decency if immediately directed to the perſons themſelves. He can admoniſh, chide, or cenſure, without giving offence. Nor is there any paſſion, but may be very advantageouſly expreſſed by this figure. When an orator has been ſpeaking of any particular perſon, on a ſudden to turn upon him, and apply the diſcourſe to that perſon himſelf, is very moving; it is like attacking an adverſary by ſurpriſe, when he is off his guard, and where he leaſt expects it. Thus Cicero: "I deſire, ſenators, to be merciful, but not to appear negligent in ſo great dangers of the ſtate; though at preſent I cannot but condemn myſelf of remiſſneſs. There is a camp formed in Italy, at the entrance of Etruria, againſt the ſtate; our enemies increaſe daily; but we ſee the commander of the camp, and general of the enemies, within our walls, in the very ſenate, contriving ſome inteſtine ruin to the ſtate. If now, Catiline, I ſhould order you to be ſeized and put to death, I have reaſon to fear, that all good men would rather think I had deferred it too long, than charge me with cruelty. But I am prevailed with for a certain reaſon not to do that yet, which ought to have been done long ſince." This ſudden turn of the diſcourſe to Catiline himſelf, and the addreſs to him in that unexpected manner, muſt have touched him very ſenſibly. So, in his defence of Milo, expreſſing his concern if he ſhould not ſucceed in it, he ſays, "And how ſhall I anſwer it to you, my brother Quintus, the partner of my misfortunes, who are now abſent?" And elſewhere addreſſing to the ſoldiers of the Martian legion, who had been killed in an engagement with Mark Antony, he thus beſpeaks them: "O happy death, which, due to nature, was paid to your country! I may eſteem you truly born for your country, who likewiſe received your name from Mars; ſo that the ſame deity ſeems to have produced this city for the world, and you for this city." And in his oration for Balbus he thus calls upon dumb nature to witneſs to Pompey's virtues: "I invoke you, mute regions; you, moſt diſtant countries; you ſeas, havens, iſlands, and ſhores. For what coaſt, what land, what place is there, in which the marks of his courage, humanity, wiſdom, and prudence, are not extant?" An appeal to heaven, or any part of inanimate nature, has ſomething very ſublime and ſolemn in it, which we often meet with in ſacred writ. So the divine prophet: "Hear, O heavens! and give ear, O earth! for the Lord hath ſpoken." And in like manner, the prophet Jeremy: "Be aſtoniſhed, O ye heavens, at this." See APOSTROPHE.

98 *Proſopopeia*, or *the fiction of a perſon*: by which either an abſent perſon is introduced ſpeaking; or one who is dead, as if he was alive and preſent; or ſpeech is attributed to ſome inanimate being. There is no figure, perhaps, which ſerves more or better purpoſes to an orator than this. For by this means he is enabled to call in all nature to his aſſiſtance, and can aſſign to every thing ſuch parts as he thinks convenient. There is ſcarce any thing fit to be ſaid, but may be introduced this way. When he thinks his own character is not of ſufficient weight to affect his audience in the manner he deſires, he ſubſtitutes a perſon of greater authority than himſelf to engage their attention. When he has ſevere things to ſay, and which may give offence as coming from himſelf; he avoids this, by putting them into the mouth of ſome other perſon from whom they will be better taken; or makes inanimate nature bring a charge, or expreſs a reſentment, to render it the more affecting. And by the ſame method he ſometimes chooſes to ſecure himſelf from a ſuſpicion of flattery, in carrying a compliment too high. We meet with ſeveral very beautiful inſtances of this figure in Cicero; but an example of each ſort may here ſuffice, beginning with that of an abſent perſon, from his defence of Milo, whom he thus introduces as ſpeaking to the citizens of Rome: "Should he, holding the bloody ſword, cry out, Attend, I pray, hearken, O citizens, I have killed Publius Clodius; by this ſword, and by this right hand, I have kept off his rage from your necks, which no laws, no courts of judicature, could reſtrain; it is by my means, that juſtice, equity, laws, liberty, ſhame, and modeſty, remain in the city. It is to be feared how the city would bear this action? Is there any one now, who would not approve and commend it?" And in his oration for Balbus, he introduces Marius, who was then dead, to plead in his defence: "Can Balbus (ſays he) be condemned, without condemning Marius for a like fact? Let him be preſent a little to your thoughts, ſince he cannot be ſo in perſon; that you may view him in your minds, though you cannot with your eyes. Let him tell you, he was not unacquainted with leagues, void of examples, or ignorant of war." And again, in his firſt invective againſt Catiline, he preſents his country as thus expoſtulating with himſelf, and upbraiding him for ſuffering ſuch a criminal as Catiline to live. "Should my country (ſays he), which is much dearer to me than my life, ſhould all Italy, all the ſtate, thus addreſs me, Mark Tully what do you do? Do you ſuffer him, whom you have found to be an enemy, who you ſee is to be at the head of the war, whom you perceive your enemies wait for in their camp as their general, who has been the contriver of this wickedneſs, the chief of the conſpiracy, the exciter of ſlaves and profligate citizens, to leave the city, which is rather to bring him in, than let him out? Will not you order him to be impriſoned, condemned, and executed? What prevents you? The cuſtom of our anceſtors? But private perſons have often puniſhed pernicious citizens in this ſtate. The laws relating to the puniſhment of Roman citizens? But traitors never had the rights of citizens. Do you fear the cenſure of poſterity? Truly you make a very handſome return to the people of Rome, who have advanced you from an obſcure condition ſo early to the higheſt dignity; if you neglect their ſafety to avoid envy, or from the apprehenſion of any danger. And if you fear cenſure; which is moſt to be dreaded, that which may ariſe from juſtice and fortitude, or from cowardice and treachery? When Italy ſhall be waſted by a war, cities plundered, and houſes burnt, do you think then to eſcape the ſevereſt cenſure." In the management of this figure, care ſhould be

Elocution. be taken that what is said be always consistent with the character introduced, in which both the force and beauty of it consist.

In treating upon figures, we have hitherto considered them separately; but it may not be amiss to observe, that some expressions consist of a complication of them, and may come under the denomination of several figures, as well verbal as those of sentences, differently considered. Thus when Cicero says, "What, Tubero, did your drawn sword do in the Pharsalian battle? At whose side was its point directed? what was the intention of your arms?" As he speaks to Tubero, it is an apostrophe; as the expressions have much the same import, and are designed to heighten and aggravate the fact, it is *exergasia;* and as they are put by question, it is *interrogation.* So likewise, in his second Philippic, where he says, "What can I think? that I am contemned? I see nothing in my life, interest, actions, or abilities, as moderate as they are, which Antony can despise. Did he think he could easily lessen me in the senate? But they, who have commended many famous citizens for their good government of the state, never thanked any but me for preserving it. Would he contend with me for eloquence? This would be a favour indeed. For what could be a larger and more copious subject, than for me speak for myself against Antony? His design was really this: he thought he could not convince his associates, that he was truly an enemy to his country, unless he was so first to me." There are three figures in this passage; *doubt*, *interrogation*, and *subjection.* And again, when he introduces Sicily thus addressing Verres in a way of complaint: "Whatever gold, whatever silver, whatever ornaments in my cities, dwellings, temples, whatever right of any kind I possessed by the favour of the senate and people of Rome; you, Verres, have plundered and taken from me." Here is a *prosopopeia*, joined with the verbal figure *anaphora*, as several members of the sentence begin with the same word. The like instances of complex figures frequently occur, and therefore we need not multiply examples of them here.

PARTICULAR ELOCUTION,

Or that part of Elocution which considers the several Properties and Ornaments of Language, as they are made use of to form different sorts of Style.

CHAP. IV. *Of Style, and its different Characters.*

99 Particular elocution treats of style and its various characters.

THE word *style* properly signifies the instrument which the ancients used in writing. For as they commonly wrote upon thin boards covered over with wax, and sometimes upon the barks of trees, they made use of a long instrument like a bodkin, pointed at one end, with which they cut their letters; and broad at the other, to erase any thing they chose to alter. And this the Latins called *stylus.* But though this be the first sense of the word, yet afterwards it came to denote the manner of expression. In which sense we likewise use it, by the same kind of trope that we call any one's writing his *hand.* Style, then, in the common acceptation of the word at present, is the peculiar manner in which a man expresses his conceptions by means of language. It is a picture of the ideas which rise in his mind, and of the order in which they are there produced. As to the reasons which occasion a variety of style, they are principally these.

Since both speech and writing are only sensible expressions of our thoughts, by which we communicate them to others; as all men think more or less differently, so consequently they in some measure differ in their style. No two persons who were to write upon one subject, would make use of all the same words. And were this possible, yet they would as certainly differ in their order and connection, as two painters, who used the same colours in painting the same picture, would necessarily vary their mixtures and disposition of them, in the several gradations of lights and shades. As every painter therefore has something peculiar in his manner, so has every writer in his style. It is from these internal characters, in a good measure, that critics undertake to discover the true authors of anonymous writings; and to show that others are spurious, and not the genuine productions of those whose names they bear; as they judge of the age of such writings from the words and manner of expression which have been in use at different times. And we may often observe in persons a fondness for some particular words or phrases; and a peculiarity in the turn or connection of their sentences, or in their transitions from one thing to another; by which their style may be known, even when they design to conceal it. For these things, through custom and habit, will sometimes drop from them, notwithstanding the greatest caution to prevent it.

There is likewise very often a considerable difference in the style of the same person, in several parts of his life. Young persons, whose invention is quick and lively, commonly run into a pompous and luxuriant style. Their fancy represents the images of things to their mind in a gay and sprightly manner, clothed with a variety of circumstances; and while they endeavour to set off each of these in the brightest and most glittering colours, this renders their style verbose and florid, but weakens the force and strength of it. And therefore, as their imagination gradually cools, and comes under the conduct of a more mature judgement, they find it proper to cut off many superfluities; so that by omitting unnecessary words and circumstances, and by a closer connection of things placed in a stronger light, if their style becomes less swelling and pompous, it is, however, more correct and nervous. But as old age sinks the powers of the mind, chills the imagination, and weakens the judgement; the style, too, in proportion usually grows dry and languid. Critics have observed something of this difference in the writings even of Cicero himself. To be master of a good style, therefore, it seems necessary that a person should be endowed with a vigorous mind and lively fancy, a strong memory, and a good judgement. It is by the imagination that the mind conceives the images of things. If the impressions of those images be clear and distinct, the style will be so too; since language is nothing but a copy of those images first conceived by the mind. But if the images are faint and imperfect, the style will accordingly be flat and languid. This is evident from the difference between such objects as are represented to our sight, and things of which we have only read or heard. For as the former generally make a deeper impression upon our minds, so we can describe them in a more strong and lively

Elocution. lively manner. And we commonly find, that according as persons are affected themselves when they speak, they are able to affect others with what they say. Now persons are more or less affected with things in proportion to the impressions which the images of those things make upon the mind. For the same reason also, if the imagination be dull, and indisposed to receive the ideas of things, the style will be stiff and heavy; or if the images are irregular and disordered, the style will likewise be perplexed and confused. When things lie straight (as we say) in the mind, we express them with ease, and in their just connection and dependence; but when they are warpt or crooked, we deliver them with pain and difficulty, as well as disorder. A good fancy should likewise be accompanied with a happy memory. This helps us to retain the names of those things the ideas whereof are presented to the mind by the imagination, together with proper and suitable phrases to express them in their several connections and relations to each other. When the images of things offer themselves to the mind, unless the names of them present themselves at the same time, we are at a loss to express them, or at least are in danger of doing it by wrong and improper terms. Besides, variety is necessary in discourse to render it agreeable; and, therefore, without a large furniture of words and phrases, the style will necessarily become insipid and jejune, by the frequent return of the same terms and manner of expression. But to both these a solid judgement is highly requisite to form a just and accurate style. A fruitful imagination will furnish the mind with plenty of ideas, and a good memory will help to clothe them in proper language; but unless they are both under the conduct of reason, they are apt to hurry persons into many inconveniencies. Such are generally great talkers, but far from good orators. Fresh images continually crowd in upon them, faster than the tongue can well express them. This runs them into long and tedious discourses, abounding with words, but void of sense. Many impertinences, if not improprieties, necessarily mix themselves with what they say; and they are frequently carried off from their point, by not having their fancies under a proper regulation. So that such discourses, though composed perhaps of pretty expressions, rhetorical flowers, and sprightly sallies of wit, yet fall very much short of a strong and manly eloquence. But where reason presides and holds the reins, every thing is weighed before it is spoken. The properest words are made choice of, which best suit the ideas they are designed to convey; rather than the most gay and pompous. All things are not said which offer themselves to the mind, and fancy dictates; but such only as are fit and proper, and the rest are dropped. Some things are but slightly mentioned, and others discoursed on more largely and fully, according to their different importance. And every thing is placed in that order, and clothed in such a dress, as may represent it to the greatest advantage. So that, in a word, the foundation of a good style is chiefly good sense. Where these qualities all meet in a considerable degree, such persons have the happiness to excel, either in speaking or writing. But this is not generally the case. Many persons of a vigorous and sprightly imagination, have but a weak judgement; and others much more judicious can think but slowly. And it is this, in a great measure, which makes the difference between speaking and writing well, as one or the other of these qualities is predominant. A person of a lively fancy, ready wit, and voluble tongue, will deliver himself off hand much better and more acceptably, than one who is capable, upon due premeditation, to discern farther into the subject, but cannot command his thoughts with the same ease and freedom. And this latter would have the same advantage of the other, were they both cooly to offer their sentiments in writing. Many things appear well in speaking, which will not bear a strict scrutiny. While the hearer's attention is obliged to keep pace with the speaker, he is not at leisure to observe every impropriety or incoherence, but many slips easily escape him, which in reading are presently discovered. Hence it is often found, that discourses, which were thought very fine when heard, appear to have much less beauty, as well as strength, when they come to be read. And therefore it is not without reason, that Cicero recommends to all those who are candidates for eloquence, and desirous to become masters of a good style, to write much. This affords them an opportunity to digest their thoughts, weigh their words and expressions, and give every thing its proper force and evidence; as likewise, by reviewing a discourse when composed, to correct its errors, or supply its defects; till by practice they gain a readiness both to think justly, and to speak with propriety and eloquence. But it is time to proceed to some other causes of the diversity of style.

Different countries have not only a different language, but likewise a peculiarity of style suited to their temper and genius. The eastern nations had a lofty and majestic way of speaking. Their words are full and sonorous, their expressions strong and forcible, and warmed with the most lively and moving figures. This is very evident from the Jewish writings in the Old Testament, in which we find a most agreeable mixture of simplicity and dignity. On the contrary, the style of the more northern languages generally partakes of the chillness of their climate. "There is (says Mr Addison*) a certain coldness and indifference in the phrases of our European languages, when they are compared with the oriental forms of speech. And it happens very luckily, that the Hebrew idioms run into the English tongue with a peculiar grace and beauty. Our language has received innumerable elegancies and improvements from that infusion of Hebraisms, which are derived to it out of the poetical passages in holy writ. They give a force and energy to our expressions, warm and animate our language, and convey our thoughts in more ardent and intense phrases than any that are to be met with in our own tongue. There is something so pathetic in this kind of diction, that it often sets the mind in a flame, and makes our hearts burn within us."

* Spect. N° 405.

Again, people of different nations vary in their customs and manners, which occasions a diversity in their style. This was very remarkable in the Attics, Asiatics, and Rhodians, and is often taken notice of by ancient writers. The Athenians, while they continued a free state, were an active, industrious, and frugal people: very polite indeed, and cultivated arts and sciences beyond any other nation: but as they had powerful enemies, and were exceedingly jealous of their liberties, this preserved them from wantonness and luxury. And their way of speaking was agreeable to their conduct; accurate and close, but very full and expressive.

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preffive. The Afiatics, on the other hand, were more gay, and loofe in their manners, devoted to luxury and pleafure; and accordingly they affected a florid and fwelling ftyle, filled with redundancies and fuperfluities of expreffion. Indeed fome of the ancients have attributed this loofenefs of ftyle to their way of purfuing eloquence at firft. For as they were put upon it by converfing with the Greek colonies who fettled among them, they fuppofe, that, in imitating them, before they were mafters of the language, they were often obliged to make ufe of circumlocutions, which afterwards became habitual, and very much weakened the force of their expreffions, as it naturally would do. But one would think, if they were put to this neceffity at firft, when they found its ill effect, they might eafily have amended it afterwards, as they grew better acquainted with the Greek language, had they been inclined fo to do. The Rhodian ftyle was a medium between the other two; not fo concife and expreffive as the Attic, nor yet fo loofe and redundant as the Afiatic. Quintilian fays, it had a mixture of its author, and the humour of the people; and like plants fet in a foreign foil, degenerated from the Attic purity, but not fo wholly as to lofe it. The firft received it from Æfchines, who being worfted in his famous conteft with Demofthenes, retired thither, and taught rhetoric, which put them upon the ftudy of eloquence.

The ftyle of the fame country likewife very much alters in different ages. Cicero tells us, that the firft Latin hiftorians aimed at nothing more than barely to make themfelves intelligible, and that with as much brevity as they could. Thofe who fucceeded them advanced a ftep farther; and gave fomewhat a better turn and cadency to their fentences, though ftill without any drefs or ornament. But afterwards, when the Greek language became fafhionable at Rome, by copying after their writers, fuch as Herodotus, Thucydides, Xenophon, and others, they endeavoured to introduce all their beauties into their own tongue, which in Cicero's time was brought to its higheft perfection. But it did not long continue in that ftate. A degeneracy of manners foon altered their tafte, and corrupted their language, which Quintilian very much complains of in his time. The cafe was the fame with refpect to the Greek tongue; though that had the good fortune to continue its purity much longer than the Latin. Nor can any language be exempt from the common fate of all human productions; which have their beginning, perfection, and decay. Befides, there is a fort of fafhion in language, as well as other things; and the generality of people are always fond of running into the mode. Perhaps fome one, or a few perfons, fall into a manner, which happens to pleafe. This gives them a reputation; and others immediately copy after them, till it generally prevail. Cicero tells us, that the moft ancient Greek orators whofe writings were extant in his time, fuch as Pericles, Alcibiades, and others, were fubtle, acute, concife, and abounded in fenfe rather than words. But another fet that followed them, of which were Critias, Theramenes, and Lyfias, retained the good fenfe of the former, and at the fame time took more care of their ftyle; not leaving it fo bare as the former had done, but furnifhing it with a better drefs. After thefe came Ifocrates, who added all the flowers and beauties of eloquence. And as he had abundance of followers, they applied thefe ornaments and decorations according to their different genius; fome for pomp and fplendor; and others to invigorate their ftyle, and give it the greater force and energy. And in this latter way Demofthenes principally excelled. Now as each of thefe manners had its peculiar beauties, and generally prevailed in different ages, Cicero thinks this could not have happened otherwife than from imitation. And he attributes it to the fame caufe, that afterwards they funk into a fofter and fmoother manner, not lefs exact and florid, but more cold and lifelefs. If we take a view of our own tongue, Chaucer feems to have been the firft who made any confiderable attempts to cultivate it. And whoever looks into his writings, will perceive the difference to be fo great from what it is at prefent, that it fcarce appears to be the fame language. The gradual improvements it has fince received, are very evident in the writers almoft of every fucceeding age fince that time; and how much farther it may ftill be carried, time only can difcover. See LANGUAGE *paffim*: For the Englifh *language* in particular, fee n° 38; for the other European languages, as well as the Greek and Latin, fee n° 27, &c.

Another caufe of the variety of ftyle arifes from the different nature and properties of language. A difference in the letters, the make of the words, and the order of them, do all affect the ftyle. So Quintilian obferves, that the Latin tongue cannot equal the Greek in pronunciation, becaufe it is harfher. The Latins want two of the fofteft Greek letters, υ and ζ; and ufe others of a very hard found, which the Greeks have not, as *f* and *q*. Again, many Latin words end in *m*; a letter of a broad and hollow found, which never terminates any Greek word; but ν does frequently, whofe found is much fofter and fweeter. Befides, in the combination of fyllables the letters *b* and *d* are often fo fituated, as to require too ftrong and unequal a force to be laid upon them, as in the words *obverfus* and *adjungo*. Another advantage of the Greek tongue arifes from the variety and different feat of the accents: for the Greeks often accent the laft fyllable, which both enlivens the pronunciation, and renders it more mufical; whereas the Latins never do this. But the greateft advantage of the Greeks lies in their plenty and variety of words; for which reafon they have lefs occafion for tropes or circumlocutions, which, when ufed from neceffity, have generally lefs force, and weaken the ftyle. But under thefe difadvantages, Quintilian feems to give his countrymen the beft advice the cafe will admit of: That what they cannot do in words, they fhould make up in fenfe. If their expreffions are not fo foft and tender, they fhould exceed in ftrength; if they are lefs fubtile, they fhould be more fublime; and if they have fewer proper words, they fhould excel in the beauty as well as number of their figures. If this account of Quintilian be juft, that the Greek tongue does furpafs the Latin in all thefe inftances, it is certain that both of them have much greater advantages over fome modern languages. The varying all their declinable words, both nouns and verbs, by terminations, and not by figns, contributes very much to the fmoothnefs and harmony of their periods. Whereas in the modern languages, thofe fmall particles and pronouns which diftinguifh the cafes of nouns and the tenfes and perfons of verbs, hinder the run of a period,

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and render the ſound much more rough and uneven. Beſides, the ancient languages ſeem to have a better and more equal mixture of vowels and conſonants, which makes their pronunciation more eaſy and muſical.

But the chief diſtinction of ſtyle ariſes from the different ſubjects or matter of diſcourſe. The ſame way of ſpeaking no more ſuits all ſubjects, than the ſame garment would all perſons. A prince and a peaſant ought not to have the ſame dreſs; and another different from both becomes thoſe of a middle ſtation in life. The ſtyle therefore ſhould always be adapted to the nature of the ſubject, which rhetoricians have reduced to three ranks or degrees; the *low* or *plain* ſtyle, the *middle* or *temperate*, and the *lofty* or *ſublime*: Which are likewiſe called *characters*, becauſe they denote the quality of the ſubject upon which they treat. This diviſion of ſtyle into three characters, was taken notice of very early by ancient writers. Some have obſerved it even in Homer, who ſeems to aſſign the *ſublime* or magnificent to Ulyſſes, when he repreſents him as ſo copious and vehement an orator, that his words came from him *like winter ſnow*. On the contrary, he deſcribes Menelaus as a *polite* ſpeaker, but *conciſe* and *moderate*. And when he mentions Neſtor, he repreſents his manner as between theſe two, not ſo high and lofty as the one, nor yet ſo low and depreſſed as the other; but ſmooth, even, and pleaſant, or, as he expreſſes it, *more ſweet than honey*. Quintilian obſerves, that although accuracy and politeneſs were general characters of the Attic writers; yet among their orators, Lyſias excelled in the *low and familiar* way; Iſocrates for his *elegancy*, *ſmoothneſs*, and the *fine turn of his periods*; and Demoſthenes for his *flame and rapidity*, by which he carried all before him. And Gellius tells us, that the like difference was found in the three philoſophers who were ſent from the Athenians to Rome (before the Romans had any reliſh for the polite arts) to ſolicit the remittance of a fine laid upon them for an injury done to a neighbouring ſtate. Carneades, one of thoſe ambaſſadors, was *vehement and rapid* in his harangues; Critolaus, *neat and ſmooth*; and Diogenes, *modeſt and ſober*. The eloquence of theſe orators, and the agreeable variety of their different manner, ſo captivated the Roman youth, and inflamed them with a love of the Grecian arts, that old Cato, who did all he could to check it by hurrying away the ambaſſadors, could not prevent their vigorous purſuit of them, till the ſtudy became in a manner univerſal. And the old gentleman afterwards learned the Greek language himſelf, when it became more faſhionable. Which a noble writer of ours * repreſents as *a puniſhment upon him for his former crime*. It ſeldom happens that the ſame perſon excels in each of theſe characters. They ſeem to require a different genius, and moſt people are naturally led to one of them more than another: though all of them are requiſite for an orator upon different occaſions, as we ſhall ſhow hereafter.

* *Lord Bacon.*

Chap. V. *Of the Low Style.*

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The low ſtyle conſidered both as to thoughts and language.

This we ſhall conſider under two heads, *thoughts* and *language*; in each of which the ſeveral characters are diſtinguiſhed from one another.

I. And with reſpect to the former, as the ſubjects proper for this ſtyle are either common things, or ſuch as ſhould be treated in a plain and familiar way; ſo plain thoughts are moſt ſuitable to it, and diſtinguiſh it from the other characters.

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Now, by plain thoughts, are meant ſuch as are ſimple and obvious, and ſeem to riſe naturally from the ſubject, when duly conſidered; ſo that any one, upon firſt hearing them, would be apt to imagine they muſt have occurred to himſelf. Not that this is really the caſe, but becauſe the more natural a thing is, the more eaſy it ſeems to be; though in reality it is often otherwiſe; and the perfection of art lies in its neareſt reſemblance to nature. And therefore, in order to ſpeak plainly and clearly upon any ſubject, it muſt firſt be duly conſidered, well underſtood, and thoroughly digeſted in the mind; which, though it require labour and ſtudy, yet the more a perſon is maſter of what he ſays, the leſs that labour will appear in his diſcourſe. This natural plainneſs and ſimplicity, without any diſguiſe or affectation, very much contributes to give credit to what is ſaid. Nor is any thing more apt to impoſe on us, than the appearance of this, when artfully aſſumed. Cicero's account of the fight between Milo and Clodius, in which Clodius was killed, is a remarkable inſtance of this. "When Clodius knew (ſays he) that Milo was obliged to go to Lanuvium upon a ſolemn and neceſſary occaſion, he immediately haſtened from Rome, the day before, to aſſaſſinate him before Clodius's own houſe, as appeared afterwards by the event. And this he did at a time, when his turbulent mob in the city wanted his aſſiſtance; whom he would not have left but for the advantage of that place and ſeaſon to execute his wicked deſign. But the next day Milo was in the ſenate, where he continued till they broke up; then went home; changed his dreſs; ſtaid there ſome time till his wife was ready; and afterwards ſet forward ſo late, that if Clodius had deſigned to return to Rome that day, he might have been here by that time. Clodius, prepared for his deſign, met him on horſeback, having no chariot, no equipage, no Greek attendants as uſual; and without his wife, which was ſcarcely ever known: whereas Milo was in a chariot with his wife, wrapt up in a cloak, and attended by a large retinue of maid ſervants, pages, and other perſons unfit for an engagement. He met with Clodius before his houſe, about five o'clock in the evening; and was preſently aſſaulted from a higher ground by many armed men, who killed the coachman. Upon which, Milo, throwing off his cloak, leaped out of the chariot, and bravely defended himſelf: and thoſe who were with Clodius, having their ſwords drawn, ſome made up to the chariot to attack Milo; and others, who now thought he had been killed, began to fall upon his ſervants who were behind. And of theſe, ſuch as had courage, and were faithful to their maſter, ſome were killed; and others when they ſaw the ſkirmiſh at the chariot, and could do their maſter no ſervice (for they heard Clodius himſelf ſay that Milo was killed, and really thought it was ſo), did that, not by their maſter's order, nor with his knowledge, nor when he was preſent, which every one would have his own ſervants to do in the like circumſtances. I do not ſay this to fix any crime upon them, but only to relate what happened." His meaning is, they killed Clodius; which he avoids mentioning, to render what he ſays leſs offenſive. Can any thing be told in a more plain and ſimple manner than this? Here is nothing ſaid, but what

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what in itself seems highly probable, and what one would imagine the fact might easily suggest to any ordinary spectator. But in this, both the art and skill of it consist. For in the whole account, as, on the one hand, Milo is so described as to render it highly improbable he could have any design at that time against Clodius; so on the other, no one circumstance is omitted which might seem proper to persuade the hearers that Clodius was the aggressor in that engagement. And yet, if we may believe Asconius, the quarrel was begun by some of Milo's retinue, and Clodius was afterwards killed by his express order. But as things are sometimes best illustrated by their opposites, we shall here produce a contrary instance of a very affected and unnatural way of relating a fact. Val. Maximus tells us of a learned man at Athens, who, by a blow which he received by a stone upon his head, entirely forgot all his learning, though he continued to remember every thing else. And therefore, as he says, since this misfortune deprived him of the greatest enjoyment of his life, it had been happier for him never to have been learned, than afterwards to lose that pleasure. This is the plain sense of the story. But now let us hear him relate it, " A man (says he) of great learning at Athens, having received a blow upon his head by a stone, retained the memory of all other things very perfectly, and only forgot his learning, to which he had chiefly devoted himself. The direful and malignant wound invading his mind, and as it were designedly surveying the knowledge reposited there, cruelly seized on that part of it in particular from which he received the greatest pleasure, and buried the singular learning of the man with an invidious funeral. Who since he was not permitted to enjoy his studies, had better never have obtained access to them, than afterwards to have been deprived of the delight they afforded him." What an unnatural way is this of relating such an accident, to talk of *a wound invading the mind*, and *surveying the knowledge reposited there*, and *cruelly seizing a particular part of it*, and *burying it with an invidious funeral?* There is nothing in the story could lead him to this, but an over-fondness to refine upon it in a very affected manner. But there are two properties of plain thoughts, one of which ought constantly to attend them in common with all thoughts, and the other is often necessary to animate and enliven this character.

The former of these is justness and propriety, which is what reason dictates in all cases. What Cicero says of the death of Crassus the orator, seems very just, as well as natural. " It was (says he) an affliction to his friends, a loss to his country, and a concern to all good men; but such public calamities followed upon it, that heaven seemed rather to have favoured him with death, than to have deprived him of life." This thought seems very just, and agreeable to the sentiments of a good man, as Crassus was; to choose death rather than to outlive the happiness of his country, to which he himself had so much contributed. Quintilian has a reflection upon a like occasion, which is not so just and becoming. It is upon the death of his only son, a youth of very uncommon parts, as he represents him; and for whose use he had designed his *Institutions of oratory;* but he died before they were finished. The passage is this: " I have lost him of whom I had formed the greatest hopes, and in whom I had reposed the greatest comfort of my old age. What can I do now? or of what farther use can I think myself to be, thus disappointed by heaven? What good parent will pardon me, if I can any longer study, and not condemn such resolution, if, thus surviving all my family, I can make any other use of my voice, than to accuse the gods, and declare that providence does not govern the world?" Allowance may be made for the sallies of passion, even in wise men, upon some shocking occasions; but when it proceeds to such a degree as to become impious, it is very indecent, as well as unjust. And all indecency is unnatural, as it is disagreeable to reason, which always directs to a decorum. That seems to be a very natural as well as just thought of Pliny the Younger, when he says, " The death of those persons always appears to me too hasty and unseasonable, who are preparing some lasting work. For persons wholly devoted to pleasures, live, as it were, from day to day, and daily finish the end for which they live; but those who have a view to posterity, and preserve their memory by their labours, always die untimely, because they leave something unfinished." We shall mention but one more instance; and that in a comparative view, to make it the more evident. The two sons of Junius Brutus, the first Roman consul, having been convicted of treason, in associating with Tarquin's party, were ordered, among others, to be put to death; and their father not only pronounced the sentence, but presided at the execution. This fact is mentioned by several of the Roman historians; and, as it carries in it not only the appearance of rigorous justice, but likewise of cruelty in Brutus, to have been present at the execution of his sons, they endeavour to vindicate him different ways. What Florus says seems rather an affectation of wit, than a just defence of the fact. " He beheaded them (says he), that being a public parent, he might appear to have adopted the whole body of the people." Nor does Val. Maximus come up to the case, who says, " He put off the father to act the consul; and chose rather to lose the sons, than be wanting to public justice." This might be a reason for condemning them; and would have been equally true, had he not been present at their execution. But Livy, whose thoughts are generally very just and natural, assigns the best reason which perhaps can be given for his vindication, when he says, " Fortune made him the executioner of the sentence, who ought not to have been a spectator." By saying *fortune made him* so, he represents it not as a matter of choice, like the other historians, but of necessity, from the nature of his office, which then obliged him to see the execution of that sentence he had himself before pronounced; as is the custom at present, in some popular governments.

The other property, which should often accompany plain and simple thoughts, is, that they be gay and sprightly. This, as has been said, is necessary to animate and enliven such discourses as require the low style. The fewer ornaments it admits of, the greater spirit and vivacity is requisite to prevent its being dry and jejune. A thought may be very brisk and lively, and at the same time appear very natural, as the effect of a ready and flowing wit. Such thoughts, attended with agreeable turns, are very suitable to this style; but care should be taken, lest, while fancy is too much indulged, the justness of them be overlooked. We shall give one instance, in which this seems to have been the case,

case, from a celebrated English work, where the ingenious writer endeavours to show the disadvantages of persons not attending to their natural genius, but affecting to imitate others in those things for which they were not formed. "The great misfortune (says he) of this affectation is, that men not only lose a good quality, but also contract a bad one; they not only are unfit for what they are designed, but they assign themselves to what they are unfit for; and instead of making a very good figure one way, make a very ridiculous one another. Could the world be reformed to the obedience of that famed dictate, *Follow nature*, which the oracle of Delphos pronounced to Cicero when he consulted what course of studies he should pursue, we should see almost every man as eminent in his proper sphere as Tully was in his. For my part, I could never consider this preposterous repugnancy to nature any otherwise, than not only as the greatest folly, but also one of the most heinous crimes; since it is a direct opposition to the disposition of providence, and (as Tully expresses it) like the sin of the giants, an actual rebellion against heaven." The advantages that arise from persons attending to their own genius, and pursuing its dictates, are here represented in a very lively and agreeable manner. But there is one thing asserted, which we fear will not hold; which is, that, *Could the world be reformed to that dictate*, "Follow Nature," *we should see almost every man as eminent in his proper sphere as Tully was in his*. For though doubtless persons would generally succeed best if they kept to this rule; yet different degrees of ability are often found, where the bias and inclination is the same, and that accompanied with equal labour and diligence. If this was not so, how happened it that no one came up to Tully in the art of oratory; especially in his own age, when there were the greatest opportunities for that study, and the highest encouragements were given to it, as it paved the way to riches, honours, and all the grand offices of the state? It cannot well be questioned but that there were other gentlemen, who had all the same advantages, accompanied with as strong a passion for this art, as Tully had, who yet fell much short of him in point of success. And experience shows, that the case has been the same in all other pursuits.

102 The language proper for this style.

III. But it is time to proceed to the other head, the *language* proper for this style. And here it may be observed in general, that the dress ought to be agreeable to the thoughts, plain, simple, and unaffected.

But the first thing that comes under consideration is elegance, or a proper choice of words and expressions; which ought always to suit the idea they are designed to convey. And therefore when an ancient writer, speaking of *cruelty*, calls it *nævus crudelitatis*, the *blemish of cruelty*; and another, applying the same word to *ingratitude*, says *nævus ingratitudinis*, the *blemish of ingratitude*; that term does not sufficiently convey to us the odious nature of either of those vices, as indeed it was not their design it should. But otherwise, where the speaker has not some particular view in doing it, to sink too low is as much a fault as to rise too high. So to call ancient Rome *the mistress of Italy*, would as much lessen the just notion of the extent of her power, as the Roman writers aggrandise it when they style her *mistress of the world*. But purity, both in the choice of words and expressions, is never more necessary than it is here. This may be called *neatness in language*. And to be plain and neat at the same time, is not only very consistent, but the former can no other way recommend itself, than as joined with the latter. Besides, the fewer advantages any thing has to set it off, the more carefully they ought to be observed. Perspicuity is always to be regarded; and serves very much to keep up the attention, where other ornaments are wanting. Epithets should be sparingly used, since they enlarge the images of things, and contribute very much to heighten the style. Indeed they are sometimes necessary to set a thing in its just light; and then they should not be dropped. Thus, in speaking of Xerxes, it would be too low and flat to say, *He descended with his army into Greece*. Here is no intimation given of their vast and unparalleled numbers, which ought to be done. Herodotus says, his whole army, of sea and land forces, amounted to 2,317,000 and upwards. Therefore, unless the number be mentioned, the least that can be said is, that *he descended with a vast army*.

The next thing to be regarded is composition, which here does not require the greatest accuracy and exactness. A seeming negligence is sometimes a beauty in this style, as it appears more natural. Short sentences, or those of a moderate length, are likewise upon the whole best suited to this character. Long and accurate periods, finely wrought up with a gradual rise, harmonious numbers, a due proportion of the several parts, and a just cadency, are therefore improper, as they are plainly the effect of art. But yet some proportion should be observed in the members, that neither the ears be too much defrauded, nor the sense obscured. Of this kind is that expression of a Greek orator, blamed by Demetrius: *Ceres came readily to our assistance, but Aristides not*. The latter member of this sentence is too short; and by dropping so suddenly, both disappoints the ears, and is somewhat obscure. It would have been plainer and more agreeable thus, *but Aristides did not come*. As to order, the plainest and clearest disposition, both of the words and members of sentences, and what is most agreeable to the natural construction, best suits with this character. For one of its principal beauties is perspicuity. And a proper connection likewise of sentences, with a regular order in the dependence of things one upon another, very much contributes to this end. With regard to the collision of syllables in different words, for preventing either a hollowness or asperity of sound, greater liberty may be taken in this style than in the other characters. Here it may be allowed to say, *Virtue is amiable to all, though all do not pursue it*. But in a higher character, perhaps, in order to prevent the hollow sound of the words *though all*, a person would choose to vary the expression a little, and say, *though few pursue it*. So, *Xerxes' expedition*, may be tolerable here; but in the florid style, *the expedition of Xerxes* would sound much better.

The last thing to be considered, with respect to the language, is dignity, or the use of tropes and figures. And as to tropes, they ought to be used cautiously; unless such as are very common, and by time have either come into the place of proper words, or at least are equally plain and clear. So in the instance mentioned above, Diodorus Siculus, speaking of the forces of Xerxes, calls them an *innumerable company*. Where, by

Elocution. by a *synecdoche*, he has chosen to make use of an uncertain number for a certain, as less liable perhaps to exception. Other examples might be given if necessary. And with regard to figures, as most of those which consist in words, and are therefore called *verbal figures*, serve chiefly to enliven an expression, and give an agreeable turn, they are often not improper for this character. Nor are figures of sentences wholly to be excluded, especially such as are chiefly used in reasoning or demonstration. But those which are more peculiarly adapted to touch the passions, or paint things in the strongest colours, are the more proper ornaments of the higher styles, as will be shown hereafter.

Upon the whole, therefore, pure nature, without any colouring, or appearance of art, is the distinguishing mark of the low style. The design of it is to make things plain and intelligible, and to set them in an easy light. And therefore the proper subjects of it are epistles, dialogues, philosophical dissertations, or any other discourses, that ought to be treated in a plain and familiar manner, without much ornament, or address to the passions. A freedom and ease both of thought and expression, attended with an agreeable humour and pleasantry, are its peculiar beauties that engage us. As we see persons of fashion and good breeding, though in the plainest habit, have yet something in their air and manner of behaviour that is very taking and amiable. Somewhat of the like nature attends this style. It has its difficulties, which are not so easily discerned but from experience. For it requires no small skill to treat a common subject in such a manner as to make it entertaining. The fewer ornaments it admits of, the greater art is necessary to attain this end. Lofty subjects often engage and captivate the mind by the sublimity of the ideas. And the florid style calls in all the assistance of language and eloquence. But the plain style is in a great measure stripped of those advantages; and has little more to recommend it, than its own native beauty and simplicity.

Chap. VI. *Of the Middle Style.*

103 This we shall treat in the same manner as we did the former, by considering first the *matter*, and then the *language* proper for it.

104 The middle style considered as to matter and language. I. And as the subjects proper for this style are things of weight and importance, which require both a gravity and accuracy of expression; so fine thoughts are its distinguishing mark, as plain thoughts are of the low character, and lofty thoughts of the sublime. Now a fine thought may deserve that character from some or other of the following properties.

And the first property we shall mention is gravity and dignity. Thus Cicero in a speech to Cæsar, says, "It has been often told me, that you have frequently said, you have lived long enough for yourself. I believe it, if you either lived, or was born for yourself only." Nothing could either be more fit and proper, than this was, when it was spoken; or at the same time a finer compliment upon Cæsar. For the civil war was now over, and the whole power of the Roman government in the hands of Cæsar; so that he might venture to say he had lived long enough for himself, there being no higher pitch of glory to which his ambition could aspire. But then there were many things in the state that wanted redressing, after those times of disorder and confusion, which he had not yet been able to effect, and of which Cicero here takes an opportunity to remind him. We shall produce another example from Curtius. Philotas, one of Alexander's captains, having formed a conspiracy against him, was convicted of it, and put to death. Amintas, who was suspected of the same crime, by reason of his great intimacy with Philotas, when he comes to make his defence, among other things speaks thus: "I am so far from denying my intimacy with Philotas, that I own I courted his friendship. Do you wonder that we showed a regard to the son of Parmenio, whom you would have to be next to yourself, giving him the preference to all your other friends? You, Sir, if I may be allowed to speak the truth, have brought me into this danger. For to whom else is it owing, that those who endeavoured to please you, addressed themselves to Philotas? By his recommendation we have been raised to this share of your friendship. Such was his interest with you, that we courted his favour, and feared his displeasure. Did we not all in a manner engage ourselves by oath, to have the same friends, and the same enemies, which you had? Should we have refused to take this, which you as it were proposed to us? Therefore, if this be a crime, you have few innocent persons about you; nay, indeed none. For all desired to be the friends of Philotas; though all could not be so who desired it. Therefore, if you make no difference between his friends and accomplices, neither ought you to make any between those who desired to be his friends, and those who really were so." Could any thing be finer spoken, more proper, and becoming the character of a soldier, than this defence; especially to a prince of so great and generous a spirit as Alexander? There is something which appears like this in Tacitus with relation to the emperor Tiberius, but falls vastly short of it in the justness and dignity of the sentiment. Sejanus, his great favourite, and partner in his crimes, falling under his displeasure, was, like Philotas, put to death for a conspiracy. Now a Roman knight, who apprehended himself in danger on account of his friendship with Sejanus, thus apologizes for himself to the emperor, in the manner of Amintas: "It is not for us to examine the merit of a person whom you raise above others, nor your reasons for doing it. The gods have given you the sovereign power of all things, to us the glory of obeying. Let conspiracies formed against the state, or the life of the emperor, be punished; but as to friendships and private regards, the same reason that justifies you, Cæsar, renders us innocent." The turn of the expressions is not much different from that in the case of Amintas; but the beauty of the thought is spoiled by the flattery of complimenting Tiberius upon an excess of power, which he employed to the destruction of many excellent men. There is not that impropriety in the defence of Amintas, which is equally brave and just.

Another property of a fine thought is *beauty* and *elegance*. It is a fine compliment which Pliny pays to the emperor Trajan, when he says, "It has happened to you alone, that you was father of your country, before you was made so." Some of the Roman emperors had been complimented with the title of *father of their country*, who little deserved it. But Trajan had a long time refused it, though he was really so, both by his good

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good government, and in the esteem of his subjects, before he thought fit to accept of it. And Pliny, among other instances of the generosity of that prince, which he mentions in the same discourse, speaking of the liberty that he gave the Romans to purchase estates which had belonged to the emperors, and the peaceable possession they had of them, does it by a turn of thought no less beautiful than the former. "Such (says he) is the prince's bounty, such the security of the times, that he thinks us worthy to enjoy what has been possessed by emperors; and we are not afraid to be thought so." There is a sprightliness in this image, which gives it a beauty; as there is likewise in the following passage of the same discourse, where he says to Trajan, "Your life is displeasing to you, if it be not joined with the public safety; and you suffer us to wish you nothing but what is for the good of those who wish it." And of the same kind is that of Cicero to Cæsar, when he says, "You, Cæsar, are wont to forget nothing but injuries." It is a very handsome, as well as just reflection, made by Tacitus upon Galba's government, that "He seemed too great for a private man, while he was but a private man; and all would have thought him worthy of the empire, had he never been emperor." The beauty of a thought may give us delight, though the subject be sorrowful; and the images of things in themselves unpleasant may be so represented as to become agreeable. Sisigambis, the mother of Darius, after the death of her son, had been treated by Alexander with the greatest regard and tenderness, in whose power she then was. So soon as she heard therefore that he was dead, she grew weary of life, and could not bear to outlive him. Upon which Q. Curtius makes this fine reflection: "Though she had courage to survive Darius, yet she was ashamed to outlive Alexander."

The next property of a fine thought, which we shall mention, is *delicacy*. As, in the objects of our senses, those things are said to be delicate which affect us gradually in a soft and agreeable manner; so a delicate thought is that which is not wholly discovered at once, but by degrees opening and unfolding itself to the mind, discloses more than was at first perceived. Quintilian seems to refer to this, when he says, "Those things are grateful to the hearers, which, when they apprehend, they are delighted with their own sagacity; and please themselves, as though they had not heard, but discovered them." Such thoughts are not unlike the sketches of some pictures, which let us into the design of the artist, and help us to discern more than the lines themselves express. Of this kind is that of Sallust: "In the greatest fortunes, there is the least liberty." This is not often so in fact, but ought to be; both to guard against an abuse of power, and to prevent the effects of a bad example to inferiors. Pliny, speaking of the emperor Trajan's entry into Rome, says, "Some declared, upon seeing you, they had lived long enough; others, that now they were more desirous to live." The compliment is fine either way, since both must esteem the sight of him the greatest happiness in life; and in that consistency lies the delicacy of the thought. It was a fine character given of Grotius, when very young, on the account of his surprising genius and uncommon proficiency in learning, that *he was born a man*: As if nature, at his coming into the world, had at once furnished him with those endowments which others gradually acquire by study and application.

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The last property of a fine thought, which we shall take notice of, is *novelty*. Mankind is naturally pleased with new things; and when at the same time they are set in an agreeable light, this very much heightens the pleasure. Indeed there are few subjects, but what have been so often considered, that it is not to be expected they should afford many thoughts entirely new; but the same thought set in a different light, or applied to a different occasion, has in some degree a claim of novelty. And even where a thing hath been so well said already, that it cannot easily be mended, the revival of a fine thought often affords a pleasure and entertainment to the mind, though it can have no longer the claim of novelty. Cicero, in his treatise of an orator, among several other encomiums which he there gives to Crassus, says of him, "Crassus always excelled every other person, but that day he excelled himself." He means as an orator. But elsewhere he applies the same thought to Cæsar, upon another account; and with some addition to it. "You had (says he) before conquered all other conquerors by your equity and clemency, but to-day you have conquered yourself; you seem to have vanquished even victory herself, therefore you alone are truly invincible. This thought, with a little variation of the phrase, has since appeared in several later writers; and it is now grown common to say of a person, who excels in any way, upon his doing better than he did before, that he has outdone himself. The like has happened to another thought, which, with a little alteration, has been variously applied. It was said by Varro, *That if the Muses were to talk Latin, they would talk like Plautus.* The younger Pliny, applying this compliment to a friend of his, says, *His letters are so finely written, that you would think the Muses themselves talked Latin.* And Cicero tells us, *It was said of Xenophon, that the Muses themselves seemed to speak Greek with his voice.* And elsewhere, that *Philosophers say, if Jupiter speaks Greek, he must speak like Plato.* The thought is much the same in all these instances, and has been since revived by some modern writers.

105 The language of the middle style.

II. We shall now consider the *language* proper for the middle style. And in general it may be observed, that as the proper subjects of it are things of weight and importance, though not of that exalted nature as wholly to captivate the mind, and divert it from attending to the diction, so all the ornaments of speech, and beauties of eloquence, have place here.

And first with regard to elegance, it is plain that a different choice of words makes a very great difference in the style, where the sense is the same. Sometimes one single word adds a grace and weight to an expression, which, if removed, the sense becomes flat and lifeless. Now such words as are most full and expressive suit best with his character. Epithets also, which are proper and well chosen, serve very much to beautify and enliven it, as they enlarge the ideas of things, and set them in a fuller light.

The most accurate composition, in all the parts of it, has place here. Periods, the most beautiful and harmonious, of a due length, and wrought up with the most exact order, just cadency, easy and smooth connec-

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tion of the words, and flowing numbers, are the genuine ornaments, which greatly contribute to form this character.

But the principal diſtinction of ſtyle ariſes from tropes and figures. By theſe it is chiefly animated and raiſed to its different degrees or characters, as it receives a leſſer or greater number of them; and thoſe either more mild, or ſtrong and powerful.

As to tropes, thoſe which afford the moſt lively and pleaſing ideas, eſpecially metaphors, ſuit the middle character. It is a pretty remark, which has been made by ſome critics upon two verſes of Virgil; one in his Eclogues, and the other in his Georgics. The former of theſe works is for the moſt part written in the low ſtyle, as the language of ſhepherds ought to be; but the latter in the middle ſtyle, ſuitable to the nature of the ſubject, and the perſons for whom it was deſigned, the greateſt men in Rome not thinking it below them to entertain themſelves with rural affairs. Now in the Eclogue, as ſome copies read the verſe, the ſhepherd, complaining of the barrenneſs of his land, ſays,

Infelix lolium et ſteriles naſcuntur avenæ.

In Engliſh thus:

Wild oats and darnel grow inſtead of corn.

But in the Georgic, where the ſame ſenſe is intended, inſtead of the proper word *naſcuntur*, *grow*, the author ſubſtitutes a metaphor, *dominantur*, *command*, and ſays,

Infelix lolium et ſteriles dominantur avenæ.

That is in Engliſh;

Where corn is ſown, darnel and oats command.

It was fit and natural for the ſhepherd to expreſs his ſenſe in the plaineſt terms; and it would have been wrong to repreſent him going ſo far out of his way, as to fetch a metaphor from government, in talking upon his own affairs. But in the Georgic, where the poet ſpeaks in his own perſon, the metaphor is much more beautiful, and agreeable to the dignity of the work. This inſtance may ſhow in ſome meaſure how the ſtyle is heightened by tropes, and the ſame thought may be accommodated to the ſeveral characters of ſtyle by the different manner of expreſſion.

The like may alſo be ſaid of figures either of words or ſentences, in reference to this character; which admits of the fineſt deſcriptions, moſt lively images, and brighteſt figures, that ſerve either for delight, or to influence the paſſions without tranſport or ecſtaſy, which is the property of the ſublime. This is indeed the proper ſeat of ſuch embelliſhments, which ſupport and make up a principal part of the middle or florid ſtyle. Having treated largely upon theſe in ſeveral preceding chapters, we ſhall here only briefly mention ſome of the moſt conſiderable.

106 Deſcriptions ornamental and pleaſant.

Deſcriptions are not only a great ornament to a diſcourſe, but repreſent things in a very lively and agreeable manner. In what a beautiful light has Cicero placed the polite arts and ſciences, when, deſcribing them from their effects, he thus repreſents to us the great advantages, as well as pleaſure, which they afford to the mind? "Other ſtudies neither ſuit with all times, nor all ages, nor all places: but theſe improve youth, delight old age, adorn proſperity, afford a refuge and ſolace in adverſity; pleaſe at home, are no hinderance abroad; ſleep, travel, and retire, with us." And they often affect us very powerfully, when they are addreſſed to the ſenſes. Quintilian has painted the calamities of a city taken by ſtorm in the brighteſt and ſtrongeſt colours, which he repreſents by "Flames ſpreading themſelves over the houſes and temples, the cracking of falling buildings, and a confuſed noiſe from a variety of cries and ſhouts; ſome running they know not where, others in the laſt embraces of their friends, the ſhrieks of children, women, and old men unhappily reſerved to ſuch diſtreſs; the plundering of all places civil and ſacred, the hurry and confuſion in carrying off the booty, captives driven before their victors, mothers endeavouring to guard their infants, and quarrels among the conquerors where the plunder is largeſt." This ſeems to be a very natural, as well as moving, image of ſo dreadful a calamity.

107 Proſopopeia well fitted for this character.

Proſopopeia is another very ſtrong and beautiful figure, very proper for this character. Seneca has a fine inſtance of it in his "Conſolatory Letter to Marcia," upon the death of her ſon. After many arguments he had made uſe of to alleviate her grief, he at laſt introduces her father, Cremutius Cordus, as thus addreſſing to her: "Imagine your father (ſays he) from the celeſtial regions, ſpeaking to you in this manner: Daughter, why do you ſo long indulge your grief? why are you ſo ignorant, as to think it unhappy for your ſon, that, weary of life, he has withdrawn himſelf to his anceſtors? Are you not ſenſible what diſorders fortune occaſions everywhere? and that ſhe is kindeſt to thoſe who have leaſt concern with her? Need I mention to you princes who had been extremely happy, had a more timely death ſecured them from impending evils? or Roman generals, who wanted nothing to conſummate their glory but that they lived too long? Why then is he bewailed longeſt in our family who died moſt happily? There is nothing, as you imagine, deſirable among you, nothing great, nothing noble; but, on the contrary, all things are mean, full of trouble and anxiety, and partake very little of the light which we enjoy." This advice was very ſuitable for a philoſopher; and he ſeems to have choſen this way of introducing it, to enforce the argument drawn from the happineſs of good men in a future ſtate, from the teſtimony of a perſon who was actually in the poſſeſſion of it.

108 Similitudes both ornamental and frequent here.

Similitudes and compariſons are another great ornament of this ſtyle, and ofteneſt found here. Nothing can be finer than the compariſon between thoſe two great orators, Demoſthenes and Cicero, made by Quintilian, when he ſays, "Demoſthenes and Cicero differ in their elocution; one is more cloſe, and the other more copious; the former concludes more conciſely, and the latter takes a larger compaſs; the one always with pungency, and the other generally with weight; one can have nothing taken from him, and the other nothing added to him; the latter has more of art, and the former more of nature. But this muſt be allowed to Demoſthenes, that he made Cicero in a great meaſure what he was. For as Tully gave himſelf wholly to an imitation of the Greeks, he ſeems to me to have expreſſed the force of Demoſthenes, the fluency of Plato, and the pleaſantry of Iſocrates." Similitudes, taken from natural things, ſerve very much to enliven the ſtyle, and

Elocution. and give it a cheerfulneſs; which is a thing ſo common and well known, that we need not ſtay to give any inſtances of it.

109 Antitheſis has alſo a fine effect. *Antitheſis*, or oppoſition, both in the words and ſenſe, has often the like beautiful effect. There is an agreeable contraſt in that paſſage of Seneca: "Cæſar does not allow himſelf many things, becauſe he can do all things: his watching defends all others ſleep, his labour their quiet, his induſtry their pleaſure, his buſineſs their eaſe; ſince he has governed the world he has deprived himſelf of it." Had he ſaid no more than only in general, that *Cæſar does not allow himſelf many things, becauſe he can do all things*, it might have paſſed for a fine thought; but, by adding ſo many particulars, all in the ſame form of expreſſion, and beginning each member with the ſame word, he has both enlarged the idea, and beautified the antitheſis, by a bright verbal figure.

Theſe, and ſuch like florid figures, are ſometimes found in hiſtorians, but oftener in orators; and indeed this middle character, in the whole of it, is beſt accommodated to the ſubjects of hiſtory and oratory.

Chap. VII. *Of the Sublime Style.*

110 The nobleſt and the moſt difficult part of an orator's province is the ſublime. The *ſublime* is the moſt noble, as well as the moſt difficult, part of an orator's province. It is this principally which Cicero requires in his perfect orator, whom he could not deſcribe in words, but only conceive of in his mind. And indeed, the nobleſt genius and greateſt art are both requiſite to form this character. For where nature has been moſt liberal in furniſhing the mind with lofty thoughts, bright images, and ſtrong expreſſions; yet without the aſſiſtance of art there will ſometimes be found a mixture of what is low, improper, or miſplaced. And a great genius, like a too rich ſoil, muſt produce flowers and weeds promiſcuouſly, without cultivation. But the juſteſt propriety, joined with the greateſt ſtrength and higheſt elevation of thought, are required to complete the true ſublime. Art, therefore, is neceſſary to regulate and perfect the taſte of thoſe who are deſirous to excel in this character.

In explaining the nature and properties of this character, we ſhall, as in the two former, conſider firſt the *thoughts*, and then the *language*; in each of which it is diſtinguiſhed from them.

§ 1. *Sublime, as it relates to Thoughts.*

111 Sublimity as it relates to thoughts. Lofty and grand ſentiments are the baſis and foundation of the true ſublime. Longinus therefore adviſes thoſe who aſpire at this excellence, to accuſtom themſelves to think upon the nobleſt ſubjects. A mind that always dwells upon low and common ſubjects can never raiſe itſelf ſufficiently to repreſent things great and magnificent in their full extent and proper light. But he who inures himſelf to conceive the higheſt and moſt exalted ideas, and renders them familiar to his thoughts, will not often be at a loſs how to expreſs them; for where proper words are wanting, by metaphors and images taken from other things, he will be able to convey them in a juſt and adequate manner. What is more common than for two perſons to conceive very differently of the ſame thing from the different manner of thinking to which they have been accuſtomed? After the great battle in Cilicia, between Alexander and Darius, in which the latter was routed, he ſent ambaſſadors to Alexander with propoſals of peace, offering him half his kingdom with his daughter in marriage. Parmenio, one of Alexander's chief captains, ſays to him upon this occaſion, "For my part, was I Alexander, I would accept of theſe conditions." "And ſo would I (replies that aſpiring monarch), was I Parmenio." The half of ſo vaſt a kingdom at preſent, and a right of ſucceſſion to the whole by marriage, was the higheſt ambition to which the thoughts of Parmenio could riſe. But Alexander had vaſtly higher views; he aimed at nothing leſs than univerſal monarchy; and therefore ſuch a propoſal ſeemed much beneath his regard. Noble and lofty thoughts are principally thoſe which either relate to divine objects, or ſuch things as among men are generally eſteemed the greateſt and moſt illuſtrious.

Of the former ſort is that of Homer, when deſcribing the goddeſs Diſcord, he ſays, that ſhe

Walks on the ground, and hides her head in clouds.

This ſtretch of thought, ſays Longinus, as great as the diſtance between heaven and earth, does not more repreſent the ſtature of the goddeſs, than the meaſure of the poet's genius and capacity. But ſuch images, however beautiful in poetry, are not ſo proper for an orator, whoſe buſineſs it is to make choice of thoſe which are ſuited to the nature of things and the common reaſon of mankind. When Numa the ſecond king of Rome was ſettled in his government, and at peace with his neighbours, in order to ſoften the fierce and martial temper of his ſubjects, who had been always accuſtomed to wars during the reign of his predeceſſor Romulus, he endeavoured to impreſs their minds with an awe of the Deity; and for that end introduced a number of religious ceremonies, which he pretended to have received from the goddeſs Egeria*. This muſt be eſteemed an artful piece of policy at that time. But that ſentiment is far more juſt and noble, with which Cicero endeavours to inſpire the members of a community, in his treatiſe Of Laws, when he ſays, that "Citizens ought firſt to be perſuaded, that all things are under the rule and government of the gods; that every affair is directed by their wiſdom and power; that the higheſt regard is due to them from men, ſince they obſerve every one's conduct, how he acts and behaves himſelf, and with what temper and devotion he worſhips them; and that they make a difference between the pious and impious." Perſons under the influence of ſuch a perſuaſion, could not fail of behaving well in ſociety. And what he ſays to Cæſar is no leſs in this ſtyle, when, interceding for Ligarius, he tells him, that "men in nothing approach nearer to deity, than in giving life to men." And Velleius Paterculus, ſpeaking of Cato, gives him this ſublime character, "That he was more like the gods than men; who never did a good thing, that he might ſeem to do it."

The other kind of lofty thoughts mentioned above, are thoſe which relate to power, wiſdom, courage, beneficence, and ſuch other things as are of the higheſt eſteem among mankind. "Your fortune (ſays Tully to Cæſar) has nothing greater than a power, nor your nature

* See Egeria.

Elocution.

nature than a will, to fave many." He fubjoins this compliment to what we juft now cited from him; and applies that to Cæfar, which was before only expreffed in general, leaving him to draw the inference of his fimilitude to deity from the clemency of his nature. And elfewhere, as in a fort of tranfport for his fuccefs in defeating the confpiracy of Catiline, he thus befpeaks the Roman fenate: "You have always decreed public thanks to others for their good government of the ftate, but to me alone for its prefervation. Let that Scipio fhine, by whofe conduct and valour Hannibal was forced to leave Italy, and retire to Africa; let the other Scipio be greatly honoured, who deftroyed Carthage and Numantia, two cities the moft dangerous to this empire; let Lucius Paulus be in high efteem, whofe triumphal chariot was adorned with Perfes, once a moft powerful and noble prince; let Marius be in eternal honour, who twice delivered Italy from an invafion and the dread of fervitude; let Pompey's name excel all thefe, whofe actions and virtues are terminated by no other bounds but the courfe of the fun;—yet among all their praifes, there will ftill fome place be left for my glory; unlefs indeed it be a greater thing to open for us new provinces to which we may refort, than to fecure a place for our victorious generals to return in triumph." And Velleius Paterculus, as if he thought no encomium too high for this great orator, laments his unhappy fate in thefe lofty ftrains, addreffed to M. Antony, by whofe order he was put to death: "You have taken from Cicero old age, and a life more miferable than death under your government; but his fame, and the glory of his actions and words, you have been fo far from deftroying, that you have increafed them. He lives, and will live in the memory of all ages; and while this fyftem of nature, however conftituted, fhall remain (which fcarce any Roman but himfelf conceived in his mind, comprehended by his genius, and illuftrated with his eloquence), the praife of Cicero fhall accompany it; and all pofterity, while it admires his writings againft you, will curfe your treatment of him; and fooner fhall mankind be loft to the world than his name." It was a noble reply of Porus the Indian king, when, after his defeat by Alexander, being brought before him, and afked *How he expected to be treated?* he anfwered, *Like a king*. And Valerius Maximus, fpeaking of Pompey's treatment of Tigranes king of Armenia after he had vanquifhed him, expreffes it in a manner fuited to the dignity and beneficence of the action, when he fays, "He reftored him to his former fortune, efteeming it as glorious to make kings as to conquer them."

But the true fublime is confiftent with the greateft plainnefs and fimplicity of expreffion. And, generally fpeaking, the more plain and natural the images appear, the more they furprife us. How fuccinct, and yet how majeftic, is that expreffion of Cæfar upon his victory over Pharnaces? *I came, I faw, I conquered.* But there cannot be a greater or more beautiful example of this, than what Longinus has taken notice of from Mofes. "The legiflator of the Jews (fays he), no ordinary perfon, having a juft notion of the power and majefty of the Deity, has expreffed it in the beginning of his laws in the following words: *And God faid*—what? *Let there be light; and there was light. Let the earth be made; and it was made.*" This inftance from the divine writer, and the character here given of him by that excellent critic, is the more remarkable, as he was himfelf a Pagan. And certainly no laboured defcription could raife in the mind a higher conception of the infinite power of the Deity, than this plain and fhort narration. To command nature itfelf into being by a *word*, reprefents it at once altogether boundlefs and unlimited.

Elocution.

It fometimes very much contributes to heighten the image of a thing, when it is expreffed in fo undetermined a manner, as to leave the mind in fufpenfe what bounds to fix to the thought. Of this kind is that of Cicero, when he firft raifes an objection againft the neceffity of an acquaintance with polite literature in order to form a great man, and then anfwers it. The objection is founded upon the examples of feveral great and excellent perfons among the Romans, who had raifed themfelves to the higheft pitch of honour and dignity, and been very ferviceable to their country, by the help of a good genius, without the advantage of much learning. In reply to which, he allows, that, where thefe are not united, nature or genius is of itfelf much preferable, and will carry a perfon further in the purfuit of great and noble defigns, than learning without a genius; but that both are neceffary to complete and perfect a truly great man. But we fhall give what he fays himfelf on this head, by which that property of a fublime thought we are now endeavouring to explain, will appear from his manner of expreffion: "I acknowledge (fays he) that many perfons of an exalted mind and virtue have, from a divine temper, without inftruction, become moderate and grave; and I add likewife, that nature, without the affiftance of learning, has frequently more contributed to honour and virtue, than learning where a genius has been wanting: But yet I muft fay, that where the direction and improvement of learning is added to a great and excellent genius, it is wont to produce fomething admirable and fingular which I know not how to defcribe." He knew very well, that by leaving the minds of his hearers thus in fufpenfe, they would form to themfelves higher conceptions of what he intended, than from any idea he could convey to them in words. We may add to this another example from the fame great orator, where he fays, "Truly, if the mind had no views to pofterity, and all its thoughts were terminated by thofe bounds in which the fpace of life is confined, it would neither fatigue itfelf with fo great labours, nor be difquieted with fo many cares and watchings, nor fo often expofe itfelf to death. But there is a certain active principle in every good man, which conftantly excites his mind by motives of glory; and reminds him, that the remembrance of his name is not to end with his life, but extend itfelf to all pofterity." Of the like nature is that of Milton, when he defcribes Satan as flying from hell in queft of our earth, then newly formed. For having reprefented that his wings failed him in the vaft vacuity, he thus defcribes his fall:

Down he drops
Ten thoufand fathom deep; and to this hour
Down had been falling, had not by ill chance
The ftrong rebuff of fome tumultuous cloud,
Inftinct with fire and nitre, hurried him
As many miles aloft.

Thofe

Thoſe words, by which his fall is expreſſed,

And to this hour,
Down had been falling,

leave the mind in ſuſpenſe, and unable to fix any bounds to the vacuity; and by that means raiſe a greater and more ſurpriſing idea of its ſpace than any direct expreſſion could have done. This image is very beautiful where it ſtands; but ſo much out of the common way of thinking, as to ſuit better with an epic poem than the diſcourſe of an orator.

§ 2. *The Sublime, with regard to Language.*

112 Sublimity as to language. What we have to offer upon this ſubject will come under the three heads of *Elegance*, *Compoſition*, and *Dignity;* which comprehend all the properties of ſtyle.

113 I. *Elegance.* Thoſe words and expreſſions chiefly contribute to form the ſublime, which are moſt ſonorous, and have the greateſt ſplendor, force, and dignity. And they are principally ſuch as theſe. Long words, when equally expreſſive, are rather to be choſen than ſhort ones, and eſpecially monoſyllables. So to conquer or vanquiſh an enemy, carries in it a fuller and grander ſound, than to beat an enemy. For which reaſon, likewiſe, compound words are often preferable to ſimple ones. So if we ſay, *Cæſar's army, when he was preſent, was always invincible;* this manner of expreſſion has more of ſublimity in it, than ſhould we ſay, *Cæſar's army, when he was preſent, could never be conquered.* But the ancient languages have much the advantage of ours in both theſe reſpects; for their words are generally longer, and they are abundantly more happy in their compoſitions. The uſe of proper epithets does alſo in a particular manner contribute to this character. For as they denote the qualities and modes of things, they are as it were ſhort deſcriptions; ſo that being joined to their ſubjects, they often greatly enlarge and heighten their image. Thus when the character of *divine poet* is given to Homer or Virgil, or *prince of orators* to Demoſthenes or Cicero, it conveys to the mind a more ſublime idea of them, than the bare mention of their name.

114 II. *Compoſition:* The force of which, as Longinus obſerves, is ſo great, that ſometimes it creates a kind of ſublime where the thoughts themſelves are but mean, and gives a certain appearance of grandeur to that which otherwiſe would ſeem but common. But compoſition conſiſts of ſeveral parts; the firſt of which, in the order we have hitherto conſidered them, is *period.* And here the caſe is much the ſame as with animal bodies, which owe their chief excellency to the union and juſt proportion of their parts. The ſeveral members, when ſeparated from each other, loſe both that beauty and force, which they have when joined together in a complete body. In like manner, ſublimity ariſes from the ſeveral parts of a period ſo connected, as to give force, as well as beauty, to the whole. The periods therefore in this character ſhould be of a proper length. If they are too ſhort, they loſe their juſt weight and grandeur, and are gone almoſt before they reach the ear; as, on the contrary, when they are too prolix, they become heavy and unwieldy, and by that means loſe their force. But more eſpecially, nothing ſuperfluous ought to be admitted, which very much enervates the force of a ſentence. We ſhall exemplify this in a paſſage from Herodotus, where he is giving an account of the famous battle at Thermopylæ between the Perſians and Lacedemonians. "Dieneces (ſays he) the Spartan, being told by a Trachinian, before the engagement with the Medes, that when the barbarians came to ſhoot their arrows, they would fly ſo thick as to obſcure the light of the ſun; he was ſo far from being terrified at this, that deſpiſing their number, he replied, he "was pleaſed with what his friend told him, ſince if the ſun was obſcured, they ſhould fight in the ſhade, and not in the ſun." The ſenſe here is great and noble, but the ſublimity of expreſſion is ſpoiled in a great meaſure by thoſe laſt words, *and not in the ſun*, which are wholly ſuperfluous. Cicero was ſenſible of this, and therefore he omits that member in relating the ſame ſtory, and ſays only: "A Spartan, hearing that one of the Perſians ſhould ſay in an inſulting manner, that when they came to engage, they ſhould not be able to ſee the ſun, for the multitude of their darts and arrows, replies, Then we ſhall fight in the ſhade." By ſtopping here he gives the ſentence much more life and emphaſis. The next thing to be conſidered in compoſition, is the order and diſpoſition of the ſeveral words and members of a ſentence. The different placing but of one or two words will ſometimes wholly deſtroy the grandeur of a ſentence, and make it extremely flat. "This public act (ſays Demoſthenes) diſpelled the danger which at that time, like a cloud, hung over the city." Let us vary the order a little, and read it thus: "This public act diſpelled the danger, which like a cloud hung over the city at that time." What a different turn does the expreſſion receive for the worſe! The ſpirit and majeſty of it are entirely loſt. And in placing the ſeveral parts or members, they ought to be ſo diſpoſed, that what is moſt weighty and important ſhould ſtand laſt. So Tully ſays of Catiline, "We ought to return thanks to heaven, that we have ſo often eſcaped ſo odious, ſo frightful, ſo dangerous a plague of the ſtate." A thing may be odious and frightful, and yet not dangerous; therefore he puts this in the laſt place, to give it the greater force, and make the deeper impreſſion. Another thing to be attended to in compoſition, is the connection of the words with regard to the ſound; that the pronunciation, in paſſing from one to another, may be moſt agreeable to the ear, and beſt ſuited to the nature of the ſubject. And as this is generally ſomething grand and magnificent, ſuch a contexture of them as will give the greateſt force and energy to the expreſſion is moſt proper for the ſublime. Soft and languid ſounds are very unſuitable to this character. They ſoothe and pleaſe the ear; but rather ſink and depreſs the mind, than excite it to things great and noble. In this reſpect, therefore, our tongue, by its multitude of conſonants, is more ſuitable for ſublime diſcourſes than ſome other modern languages, which abound with vowels.

III. The laſt head to be conſidered, is the proper uſe of tropes and figures, which is here ſo neceſſary, 115
that the title of *dignity* ſeems to have been given to this part of elocution, from the aſſiſtance it more eſpecially affords to this character. For if, as has been obſerved from Longinus, compoſitions will ſometimes create a

a ſort of ſublimity; this much oftener happens from the force and efficacy of ſome lively tropes and ſtrong figures.

And as to *tropes*, bright metaphors are peculiarly ſuited to raiſe and animate the ſtyle. This is manifeſt from the nature of them, as they conſiſt of contracted ſimilies, reduced to a ſingle word; which, if taken from things lofty and grand, muſt of conſequence give a ſublimity to the ſtyle. What can ſuggeſt to us a greater idea of the valour of Ajax, than Homer's calling him *the bulwark of the Greeks;* or of the Scipios, than when they are ſtyled by Virgil, *the two thunderbolts of war.* A number of thoſe, well choſen, contributes no leſs to the grandeur than to the beauty of diſcourſe. Hyperbole ſometimes gives the ſame force to an expreſſion, if cautiouſly uſed; and ſo as not to exceed all appearance of truth. But the chief uſe of it is, where proper words will not expreſs the juſt idea of the thing deſigned to be conveyed; and it may ſeem rather the offspring of neceſſity than choice. Of this nature is that of Herodotus, when ſpeaking of the Lacedæmonians at Thermopylæ, he ſays, "They defended themſelves with the ſwords they had left, and even with their hands and teeth, till the barbarians buried them under their arrows." It cannot be ſuppoſed ſtrictly true, that ſo many arrows were thrown at them as to bury them; but having in the former part of the ſentence repreſented their reſolute defence in the ſtrongeſt terms, by ſaying, that naked and without arms, they engaged armed men with their hands and teeth, the following hyperbole ſeems not unnatural, and to intimate nothing more than what was neceſſary to quell ſuch obſtinate reſolution and courage.

As to *figures*, whether verbal or thoſe which conſiſt in the ſenſe, the nature of this character will eaſily direct to ſuch as are moſt proper. But with reſpect to the latter, poets take greater liberties in the uſe of them than would be allowed in an orator. As their images are often formed for pleaſure and delight, ſo they carry in them more of rapture and tranſport. But the orator's uſe of them being to ſet things in a ſtronger and clearer light, they are more ſedate and moderate. Beſides, an orator ſcarce ever has occaſion for ſuch fictitious images as we often meet with in poetry; though his ought to appear as natural, and its painting as ſtrong and lively. We ſhall juſt mention ſome of the chief of thoſe figures which ſeem beſt ſuited for this purpoſe; though they are no leſs ſuited to the middle ſtyle, as has been ſhown already, when taken from ſubjects of an inferior nature.

116 1. *Deſcription.* Of this Juſtin gives us a fine inſtance, in a ſpeech of King Philip of Macedon, wherein he repreſents the neceſſity of falling upon the Romans, who at that time were engaged in a war with Hannibal. "I behold (ſays he) a cloud of a moſt dreadful and bloody war riſing in Italy. I ſee a ſtorm of thunder and lightning from the weſt, which will overſpread all places with a vaſt ſhower of blood, into whatever country the tempeſt of victory ſhall drive it. Greece has undergone many violent ſhocks in the Perſian, Gallic, and Macedonian wars; but theſe would all be found unworthy of regard, if the armies now engaged in Italy ſhould march out of that country. I view the terrible and cruel wars which involve thoſe nations through the courage of their forces, and ſkill of their generals. This rage and fury cannot ceaſe by the deſtruction of one party, without the ruin of their neighbours. Indeed, Macedon has leſs reaſon to dread the ſavage conquerors than Greece; becauſe more prepared, and better able to defend itſelf; but I am ſenſible, thoſe who attack each other ſo impetuouſly will not confine their victories within thoſe bounds, and that it will be our lot to engage the conquerors." So lively a picture of imminent and threatening danger muſt needs alarm the moſt timorous, and excite them to a reſolution to defend their country, and all that was dear to them. Such images give life and vigour to a diſcourſe, and being artfully interwoven with proper arguments, influence the mind, and carry it away by an irreſiſtible force, ſo that the hearer is not barely left to conclude the certainty of the thing, but moved by it, as it were, from ocular demonſtration. The images therefore of the orator ought to be drawn from real things, or at leaſt ſuch as are probable; for if they are wholly fictitious and incredible, as many poetical images are, they may give pleaſure, but will not convince the mind, nor ſway the paſſions.

2. *Enumeration* has ſome affinity with the former figure; by which, if the ſeveral parts have each ſomething grand in them, the whole, when brought together, and diſpoſed in a juſt order, very much contributes to the ſublimity. We ſhall produce an example 117
of this from an Engliſh writer, containing a deſcription of our globe, upon a ſurvey of it after the general conflagration, which he repreſents in this ſtrong light: "Such is the vanity and tranſient glory of this habitable world! By the force of one element breaking looſe upon the reſt, all the varieties of nature, all the works of art, all the labours of man, are reduced to nothing; all that we admired and loved before, as great and magnificent, is obliterated and vaniſhed, and another form and face of things, plain, ſimple, and everwhere the ſame, overſpreads the whole earth. Where are now the great empires of the world, and their great imperial cities? their pillars, trophies, and monuments of glory? Show me where they ſtood, read the inſcription, tell me the victor's name. What remains, what impreſſions, what difference or diſtinction, do you ſee in this maſs of fire? Rome itſelf, eternal Rome, the great city, the empreſs of the world, whoſe domination or ſuperſtition, ancient or modern, make a great part of the hiſtory of the earth, what is become of her now? She laid her foundations deep, and her palaces were ſtrong and ſumptuous; *ſhe glorified herſelf, and lived deliciouſly, and ſaid in her heart I ſit a queen, and ſhall ſee no ſorrow:* but her hour is come, ſhe is wiped away from the face of the earth, and buried in everlaſting oblivion. But it is not cities only, and the works of men's hands; the everlaſting hills, the mountains and rocks of the earth, are melted as wax before the ſun, *and their place is nowhere found.* Here ſtood the Alps, the load of the earth, that covered many countries, and reached their arms from the ocean to the Black ſea. This huge maſs of ſtone is ſoftened and diſſolved, as a tender cloud into rain. Here ſtood the African mountains, and Atlas with his top above the clouds. There was frozen Caucaſus, and Taurus, and Imaus, and the mountains of Aſia; and yonder, towards the north, ſtood the Riphean hills, clothed in ice and ſnow; all theſe are vaniſhed, dropped away as the ſnow upon their

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their heads *." These particulars considered separately are all truly great and noble, and every way suited to the nature of the subject; but as they are here disposed, and rise in order, they both enlarge the idea, and heighten the image, of that grand catastrophe.

* *Burnet's Theory.*

118 3. *Similitude:* which serves very much for beauty and ornament; and, when taken from great and sublime objects, adds a grandeur and magnificence to the things illustrated by it. We need go no farther for an example of this, than to the great critic so often mentioned already, who has treated upon the sublime in a style every way equal to the subject. He, then, comparing those two great works of Homer, his Iliad and Odyssey, thus describes them: "Homer composed his Iliad when his mind was in its full strength and vigour; the whole body of the poem is dramatic, and full of action: whereas the best part of the Odyssey is taken up in narrations, which seem to be the genius of old age. So that one may compare him in this latter work to the setting sun, which still appears with the same magnificence, but has no longer the same heat and force." And soon after, speaking of the Odyssey, he says, "That piece may be called the reflux of his genius, which like the ocean ebbs, and deserts its shores." What nobler idea could possibly have been given of that great poet, than by those two similitudes of the sun and the ocean? And elsewhere, comparing those two great orators Demosthenes and Cicero, he shows the like sublimity of thought. "Demosthenes (says he) is sublime, in that he is close and concise; Cicero, in that he is diffuse and extensive. The former, by reason of the violence, rapidity, strength, and fury, with which he rages and bears all before him, may be compared to a tempest, and thunder; but the latter, like a great conflagration, devours and consumes all he meets, with a fire that is never extinguished, but wherever it advances continually gathers new strength."

119 4. *Antithesis*, or a sentence consisting of opposite parts, has often the same effect; as in the following instance of Cicero, where his view is to represent Pompey as a most consummate general. "Who (says he) ever was, or need be more knowing than this man? who from his childhood, and instruction at school, went into the army of his father, and learned the military art, in a very great war against the fiercest enemies: who, while yet a boy, became a soldier under the greatest general; and when but a youth was himself commander of a very great army: who has oftener engaged with the enemy in battle, than any other person with his adversary in private contests: has waged more wars than others have read, and conquered more provinces than others have wished to govern: whose youth has been spent in acquiring the art of war, not by the precepts of others, but his own commands; not by defeats, but victories; not by campaigns but triumphs."

120 5. *Apostrophe.* Among the articles charged against Demosthenes by his great adversary and rival Æschines, one was, that he had advised the Athenians to engage in a war against King Philip, wherein they had received a very great defeat. When Demosthenes comes to answer that part of the charge, he does not say, as he might, "You have not been misled, my fellow-citizens, in exposing your lives for the liberties and safety of Greece; you are not without the most illustrious examples of such conduct: for who can say these great men were misled, who fought for the same cause in the plains of Marathon?" But instead of expressing himself thus, he gives the matter quite a different turn; and in a sort of rapture, appealing to those brave defenders of their country, says, "No, my fellow-citizens, you have not done wrong, you have not; I protest by the ghosts of those great men who fought for the same cause in the plains of Marathon." By this appeal to those ancient worthies whose memories were in the highest esteem at Athens, that it was the cause, and not the success, which rendered their actions so glorious, he artfully corroborates his assertion in a way which he knew must have the greatest weight with his audience.

As the proper subjects of this character are either divine things, or such as are in the highest esteem and regard among mankind, which often require laudatory discourses, or panegyric; these naturally admit of all the ornaments and assistance of eloquence. Which, however, must be used with discretion; for when the mind is wrapt up in thought, and stretched to the utmost of its powers in the pursuit of some noble and sublime idea, it cannot attend to all the lesser fineries and niceties of language; but from its own vigour, and lively conception of things, will be led to express them in terms the most emphatical, and best suited to their nature. In such cases, therefore, the sublimity must appear rather from the elevation of the thought, attended with a simplicity of expression, than from the ornaments and dress of the language. These things seem more natural when the mind is relaxed, and employed upon lower objects. Though, upon the whole, grandeur and majesty of expression is the proper mark of this character with relation to the language, as beauty and splendor is of the middle style.

Chap. VIII. *Of the Style of an Orator.*

THE style of an orator comprehends all the characters already explained, of *low*, *middle*, and *sublime*, as they are applied by him in the different parts of his province. For that the language must be suited to the nature of the subject, we have had occasion often to observe already; and the different view of the speaker or writer necessarily occasions a variety in the manner of expression. Now an orator has three things in his view; to prove what he asserts, to represent it in an agreeable light, and to move the passions. These are all necessary, we do not mean in the order wherein we have now mentioned them, but that the discourse may upon the whole have its desired effect upon the audience. For unless the mind be convinced of the truth of what is offered by solid and cogent arguments, neither will the most eloquent discourse afford a lasting pleasure, nor the most pathetic long influence the affections. Though, on the other hand, the hearers expect to be entertained at the same time they are informed; and, therefore, unless the language be agreeable to their taste, they will soon call off their attention, and think but meanly of the speaker. And unless both these are warmed and animated by a becoming pathos, the speaker may very probably miss of his end in bringing his audience over

121 The *low*, *middle*, and *sublime* style requisite for an orator.

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over to his ſentiments. For bare conviction is not ſufficient with many perſons to excite them to action. They will acquieſce in the truth of a thing which they cannot contradict, or will not give themſelves the trouble to examine; and at the ſame time remain unconcerned to proſecute it. And the pleaſure of a florid diſcourſe will of itſelf ſoon vaniſh, like the harmony of muſic, or the charms of a fine poem. And therefore to captivate his audience, ſecure them in his intereſt, and puſh them upon action, it is neceſſary for the orator to engage their affections; theſe are, as it were, the ſprings of the ſoul, which, managed by a ſkilful hand, move and direct it at pleaſure. Now each of theſe parts of an orator's province requires a different ſtyle. The *low-ſtyle* is moſt proper for proof and information; becauſe he has no other view here but to repreſent things to the mind in the plaineſt light, as they really are in themſelves, without colouring or ornament. The *middle ſtyle* is moſt ſuited for pleaſure and entertainment, becauſe it conſiſts of ſmooth and well-turned periods, harmonious numbers, with florid and bright figures. But the *ſublime* is neceſſary in order to ſway and influence the paſſions. Here the orator calls in all the aſſiſtance both of nature and art; the moſt raiſed and lofty thoughts, clothed with the brighteſt and ſtrongeſt colouring, enter into this character.

But as an orator has frequently each of theſe views in the ſame diſcourſe, we ſhall firſt give a ſummary deſcription of the ſeveral characters of ſtyle, which we have formerly diſcourſed on more at large; that, by placing them together in one view, the difference between them may be more plain and obvious: and then we ſhall proceed to ſhow to what particular parts of a diſcourſe each of them is more eſpecially to be applied.

I. Firſt, then, as ſhorter periods are proper in the *low ſtyle*, ſo leſs care is neceſſary in their turn and cadency. If a ſentence now and then drop unexpectedly and diſappoint the ear, or has ſomething rough and harſh in its compoſition, it is no blemiſh in this character. For as it is ſuited to the manner of common diſcourſe, an appearance of regard to the ſubject, rather than the form of expreſſion, is more becoming than any beauties of art. But the words ſhould be well choſen and proper, ſuited to the ideas they are deſigned to convey; the expreſſions plain and clear, and the artificial ornaments few and modeſt. By *artificial ornaments*, are here meant *tropes* and *figures;* and they are called *artificial*, becauſe they vary from the natural dreſs of language, either in the words or manner of expreſſion: though they are often uſed by thoſe who are wholly unacquainted with the rules of art; and particularly metaphors, which perſons who have the leaſt command of language frequently run into through mere neceſſity, for want of a ſufficient ſtock of proper words to convey their ideas. The low ſtyle therefore admits of theſe: but care ſhould be taken to chooſe ſuch as have been rendered familiar by uſe, or at leaſt where the ſimilitude is very plain and evident. Bold or lofty metaphors, or where the alluſion is dark and remote, ought to be avoided. Nor is the moderate uſe of the other tropes wholly diſagreeable to this ſtyle. And the ſame thing is to be ſaid with reſpect to verbal figures, or ſuch as conſiſt in the particular diſpoſition of the ſentence, ſo that if the form of it be changed, the figure is loſt. Of theſe, ſuch as come neareſt to the natural way of expreſſion are moſt proper for this ſtyle; and therefore thoſe which conſiſt in a jingle of words, ariſing from the ſame or a like ſound, are to be avoided, as carrying in them too much the appearance of art. Thoſe likewiſe which conſiſt in a repetition of the ſame word have often too great a force and vehemence for this mild and gentle character. And as to figures of ſentences, which do not depend on the conſtruction of words, but lie in the ſenſe, many of them are too gay and ſprightly, and others too rapid and impetuous, for the ſimplicity of the low ſtyle; ſo that only the more moderate and ſedate ones are to be allowed a place here. It is therefore no wonder if perſons are often miſtaken in their notions of this character: the beauty of which conſiſting in a certain plainneſs and ſimplicity, without any thing in it but what ſeems natural and common, every one is apt to imagine he can readily be maſter of it, till by experience he finds the contrary. For the caſe is much the ſame here, as in perſons of faſhion and good breeding, whoſe behaviour and addreſs is attended with that agreeable freedom and ſeeming negligence, which in appearance is very eaſy to expreſs, but in reality is ſcarce imitable by others.

As the *middle ſtyle* is more adapted for pleaſure and delight, it admits of all thoſe beauties and ornaments which ſoothe and entertain the mind. It has more force and energy than the low ſtyle, but leſs than the ſublime. Smooth and harmonious numbers, well turned periods, of a juſt length, delightful cadency, and accurate diſpoſition of the words, are ſuited to this ſtyle. The moſt beautiful and ſhining tropes, which ſtrike the fancy, and all thoſe verbal figures which, by a repetition, ſimilitude, or proportion of ſounds, pleaſe and gratify the year, help to form this character. The like is to be ſaid as to figures of ſentences: The moſt florid and beautiful, ſuch as enumeration, deſcription, ſimilitude, and the like, are here the moſt proper.

But it is the *ſublime ſtyle* which perfects the orator. This requires the moſt forcible and emphatical words, the boldeſt metaphors and ſtrongeſt figures. In verbal figures, repetitions, ſynonyms, gradations, contraries, with others of a like force and energy, are chiefly employed here. But figures of ſentences are the moſt conſiderable, and principally contribute to make up this character. Among theſe are ſimilies taken from lofty ſubjects, proſopopœia, apoſtrophe, exclamation, epiphonema, apoſiopeſis, and others of a like nature. But due care muſt likewiſe be taken of the form, conſtruction, and harmony of the periods; which ſeem beſt diſpoſed, when long and ſhort ones are intermixed. For though round and ſwelling periods carry in them ſomething grand and majeſtic, yet many times they move too ſlow to ſtrike the paſſions; whereas ſhort ones are more acute and pungent, and by returning quick, awaken the mind, and raiſe the paſſions. But to render it complete, it muſt be ſupported with ſtrong reaſon, grandeur of thought, and ſentiments every way equal to the expreſſion; without which it will be very liable to ſwell into bombaſt, and end barely in amuſement.

II. Having given a ſhort ſketch of this part of the orator's furniture, we ſhall now go on to ſhow where, and in what manner, he is to make uſe of it. This will

will beſt appear by conſidering his principal view in each part of his diſcourſe. Now the parts of a juſt oration (as we have formerly ſhown) are ſix; *Introduction*, *Narration*, *Propoſition*, *Confirmation*, *Confutation*, and *Concluſion*. Not that all theſe are neceſſary in every diſcourſe, but it is proper they ſhould all be mentioned, that we may conſider what ſtyle is fitteſt for them when they are neceſſary.

122 In the *Introduction*, the orator has three things before him; to gain the eſteem of his hearers, to ſecure their attention, and to give them ſome general notion of his ſubject. To ſet out modeſtly is undoubtedly the moſt likely way to recommend himſelf. For to attempt to inflame an audience, before they are prepared for it, or ſee the reaſon of much warmth, is highly improper. A prudent ſpeaker will, like Demoſthenes, begin with temper, and riſe gradually, till he has inſenſibly warmed his hearers, and in ſome degree engaged their affections in his favour. So that this part ſcarcely riſes above the middle ſtyle. And if it carry in it an air of pleaſantry and good-humour, it is generally the more apt to engage the attention.

123 The introduction is uſually followed by the *narration*, or a recital of ſuch things as either preceded, accompanied, or followed upon the ſubject under conſideration. Now, as the qualities that recommend a narration are clearneſs, brevity, and probability; theſe ſufficiently point out the ſtyle. Perſpicuity ariſes from the choice of proper words, and ſuch tropes as have been rendered moſt familiar by uſe; brevity requires moderate periods, whoſe parts are but little tranſpoſed; and a plain and ſimple dreſs, without ornament or colouring, is beſt ſuited to repreſent things probable: all which are the properties of the low ſtyle. And therefore Cicero ſays, *narrations come pretty near to our ordinary diſcourſe*. Indeed, ſometimes it is neceſſary not only to relate the facts themſelves, but likewiſe to deſcribe the manner in which they were performed. And then a further degree of art may be requiſite to repreſent them with all their circumſtances, and paint them to the mind in their proper colours.

124 The next part in order is the *propoſition*, or ſubject of the diſcourſe, in which there can be no room for ornament. But as it is the baſis and foundation of the orator's whole deſign, it ought to be laid down in the plaineſt and cleareſt terms, ſo as to leave no room for doubt or uncertainty what it is which he intends to diſcourſe upon.

125 The next thing is *confirmation*, wherein the orator endeavours to maintain and defend his own cauſe, and to convince his hearers of the truth of it by reaſon and argument. Now the low ſtyle is certainly fitteſt for cool reaſoning and debate. But the orator's method of reaſoning often very much differs from that of the philoſopher. The latter contents himſelf with the moſt plain and familiar manner of repreſenting the truth, and thinks it ſufficient if what he ſays be clearly underſtood. But the former, at the ſame time that he convinces the judgement, endeavours likewiſe to affect the paſſions, and that in a great variety of ways. So that in this part of the diſcourſe the ſtyle is very different, according to the nature and circumſtances of the caſe. Sometimes, while he is dwelling upon the proof of a thing, he talks coolly, and reaſons with the ſedateneſs of a philoſopher; and where any part of his argument appears doubtful or obſcure, he endeavours with the ſame even temper to explain and clear it up. But frequently he intermixes with his proofs all the arts of perſuaſion, and embelliſhes his reaſons with the greateſt ornaments and beauties of eloquence.

Confirmation is uſually followed by *confutation*, in 126
which the orator endeavours to enervate and overthrow all that has been advanced in favour of the oppoſite ſide of the queſtion. But as the ſtyle is much the ſame here as in the former part, what has been ſaid upon that may be ſufficient for this likewiſe.

The laſt part abovementioned is the *concluſion*. 127
This conſiſts of two branches, *recapitulation*, and *addreſs*. Recapitulation is a ſhort recital of the ſeveral arguments, at the leaſt the chief of them, which were before advanced in ſupport of the cauſe; that, being brought together into a narrow compaſs, they may appear in a ſtronger light. Wherefore the language here ought rather to be forcible and ſtrong than florid, becauſe brevity and conciſeneſs is a neceſſary quality. The other branch of the concluſion conſiſts in an addreſs to the paſſions, and is wholly perſuaſive; for which the ſpeaker is now entirely at leiſure. Indeed, this is often done occaſionally in other parts of the diſcourſe, particularly in the introduction and confirmation: But, as in the former of theſe, his view is principally to ſecure the good opinion of the hearers, and excite their attention; and in the latter to defend his own ſide of the queſtion by reaſon and argument; when theſe two points are gained, he has nothing left but to prevail with them to fall in with his deſign, and declare for him. And the beſt way to attain this is, by engaging their paſſions in his intereſt. Hence, then, to uſe Quintilian's words, "All the ſprings of eloquence are to be opened. Now we are paſt the rocks and ſhallows, all the ſails may be hoiſted. And as the greateſt part of the concluſion conſiſts in illuſtration, the moſt pompous language and ſtrongeſt figures have place here."

All the variety above mentioned, however, is not always neceſſary. Regard muſt be had to the nature of the ſubject, the time, place, perſons, and other circumſtances; by all which the ſtyle is to be regulated. To diſcourſe in a lofty and grand way upon a common topic, or in a low and flat manner upon a ſublime argument, are both equally injudicious. Cicero refers us to ſome diſcourſes of his own, as inſtances of each kind. His oration for Cæcina, he ſays, is written in the low ſtyle, that for the Manilian law in the middle ſtyle, and that for Rabirius in the ſublime; and his Actions againſt Verres, with ſome others, are patterns of the variety here mentioned. And he gives us a very comprehenſive deſcription of a perfect orator in very few words, when he ſays, "He is one who can ſpeak upon a low ſubject acutely, upon a lofty ſubject with ſublimity, and upon a moderate ſubject temperately." By which he means no more, than one who is maſter of the three characters here deſcribed, and knows when and how to uſe them. But although he mentions ſeveral among the Greeks, and ſome few among the Romans, who excelled in one or other of theſe different kinds; yet one who excelled in them all, he ſuppoſes never to have exiſted, except in the imagination. The reaſon perhaps

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perhaps may be, becauſe each of them ſeems to require a very different genius, ſo that it is ſcarce poſſible for the ſame perſon to ſucceed in them all. Since therefore it is ſo rare and difficult a matter to gain the command of each in any good degree, it is better perhaps for every one to purſue that which nature ſeems moſt inclined to, and to excel in it, than to ſtrive againſt their genius. For every kind has its perfections; and it is more commendable to be maſter of one thing, than to do ſeveral but indifferently.

Part IV. Of PRONUNCIATION.

Chap. I. *Of Pronunciation in general.*

128 Pronunciation a conformity of the voice and geſture to the ſubject.

PRONUNCIATION is alſo called *Action* by ſome of the ancients. Though, if we attend to the proper ſignification of each of theſe words, the former reſpects the voice, and the latter the geſtures and motions of the body. But if we conſider them as ſynonymous terms, in this large ſenſe pronunciation or action may be ſaid to be *a ſuitable conformity of the voice, and the ſeveral motions of the body, in ſpeaking, to the ſubject matter of the diſcourſe.*

The beſt judges among the ancients have repreſented this as the principal part of an orator's province, from whence he is chiefly to expect ſucceſs in the art of perſuaſion. When Cicero, in the perſon of Craſſus, has largely and elegantly diſcourſed upon all the other parts of oratory, coming at laſt to ſpeak of this, he ſays: "All the former have their effect as they are pronounced. It is the action alone that governs in ſpeaking; without which the beſt orator is of no value, and is often defeated by one in other reſpects much his inferior." And he lets us know, that Demoſthenes was of the ſame opinion, who, when he was aſked what was the principal thing in oratory, replied, action; and being aſked again a ſecond and a third time, what was next conſiderable, he ſtill made the ſame anſwer. By which he ſeemed to intimate, that he thought the whole art did in a manner conſiſt in it. And indeed, if he had not judged this highly neceſſary for an orator, he would ſcarce have taken ſo much pains in correcting thoſe natural defects, under which he laboured at firſt, in order to acquire it. For he had both a weak voice, and likewiſe an impediment in his ſpeech, ſo that he could not pronounce diſtinctly ſome particular letters. The former of which defects he conquered, partly by ſpeaking as loud as he could upon the ſhore, when the ſea roared and was boiſterous; and partly by pronouncing long periods as he walked up hill; both of which methods contributed to the ſtrengthening of his voice. And he found means to render his pronunciation more clear and articulate, by the help of ſome little ſtones put under his tongue. Nor was he leſs careful in endeavouring to gain the habit of a becoming and decent geſture; for which purpoſe he uſed to pronounce his diſcourſes alone before a large glaſs. And becauſe he had got an ill cuſtom of drawing up his ſhoulders when he ſpoke; to amend that, he uſed to place them under a ſword, which hung over him with the point downward. Such pains did this prince of the Grecian orators take to remove thoſe difficulties, which would have been ſufficient to diſcourage an inferior and leſs aſpiring genius. And to how great a perfection he arrived in his action, under all theſe diſadvantages, by his indefatigable diligence and application, is evident from the confeſſion of his great adverſary and rival in oratory, Æſchines. Who, when he could not bear the diſgrace of being worſted by Demoſthenes in the cauſe of Cteſiphon, retired to Rhodes. And being deſired by the inhabitants to recite to them his own oration upon that occaſion, which accordingly he did; the next day they requeſted of him to let them hear that of Demoſthenes; which having pronounced in a moſt graceful manner, to the admiration of all who were preſent, "How much more (ſays he) would you have wondered if you had heard him ſpeak it himſelf!" By which he plainly gave Demoſthenes the preference in that reſpect. We might add to theſe authorities the judgement of Quintilian, who ſays, that "it is not of ſo much moment what our compoſitions are, as how they are pronounced; ſince it is the manner of the delivery by which the audience is moved." And therefore he ventures to aſſert, that "an indifferent diſcourſe, aſſiſted by a lively and graceful action, will have greater efficacy than the fineſt harangue which wants that advantage."

The truth of this ſentiment of the ancients concerning the power and efficacy of pronunciation, might be proved from many inſtances; but one or two may here ſuffice. Hortenſius, a contemporary with Cicero, and while living next to him in reputation as an orator, was highly applauded for his action. But his orations after his death, as Quintilian tells us (for we have none of them now remaining), did not appear anſwerable to his character; from whence he juſtly concludes, there muſt have been ſomething pleaſing when he ſpoke by which he gained his character, which was loſt in reading them. But perhaps there is ſcarce a more conſiderable inſtance of this than in Cicero himſelf. After the death of Pompey, when Cæſar got the government into his own hands, many of his acquaintance interceded with him in behalf of their relations and friends, who had been of the contrary party in the late wars. Among others, Cicero ſolicited for his friend Ligarius; which Tubero underſtanding, who owed Ligarius a grudge, he oppoſed it, and undertook to repreſent him to Cæſar as unworthy of his mercy. Cæſar himſelf was prejudiced againſt Ligarius; and therefore, when the cauſe was to come before him, he ſaid, "We may venture to hear Cicero diſplay his eloquence; for I know the perſon he pleads for to be an ill man, and my enemy." But, however, in the courſe of his oration, Cicero ſo worked upon his paſſions, that by the frequent alteration of his countenance, the emotions of his mind were very conſpicuous. And when he came to touch upon the battle of Pharſalia, which had given Cæſar the empire of the world, he repreſented it in that moving and lively manner, that Cæſar could no longer contain himſelf, but was thrown into ſuch a fit of ſhivering, that he dropped the papers which

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which he held in his hand. This was the more remarkable, because Cæsar was himself one of the greatest orators of that age, knew all the arts of address, and avenues to the passions, and consequently was better prepared to guard against them. But neither his skill, nor resolution of mind, was of sufficient force against the power of oratory; but the conqueror of the world became a conquest to the charms of Cicero's eloquence; so that, contrary to his intention, he gave into his plea, and pardoned Ligarius. Now that oration is still extant, and appears exceedingly well calculated to touch the soft and tender passions and springs of the soul; but we believe it can scarce be discernible to any in reading it, how it should have had so surprising an effect; which must therefore have been chiefly owing to the wonderful address and conduct of the speaker.

The more natural the pronunciation is, it will of consequence be the more moving, since the perfection of art consists in its nearest resemblance to nature. And therefore it is not without good reason, that the ancients make it one qualification of an orator, that he be a good man; because a person of this character will make the cause he espouses his own, and the more sensibly he is touched with it himself, his action will be the more natural, and by that means the more easily affect others in the same manner. Cicero, speaking upon this subject, says, "It is certain that truth (by which he means nature) in every thing excels imitation; but if that was sufficient of itself in action, we should have no occasion for art." In his opinion therefore (and who was ever a better judge), art, in this case as well as in many others, if well managed, will assist and improve nature. But that is not all; for sometimes we find the force of it so great and powerful, that, where it is only counterfeit, it will for the time work the same effect as if it was founded in truth. This is well known to those who have been conversant with the representations of the theatre. In tragedies, though we are sensible that every thing we see and hear is feigned and counterfeit, yet such is the power of action, that we are oftentimes affected by it in the same manner as if they were all realities. Anger and resentment at the appearance of cruelty, concern and solicitude for distressed virtue, rise in our breasts; and tears are extorted from us for oppressed innocence, though at the same time, perhaps, we are ready to laugh at ourselves for being thus decoyed. If art then has so great an influence upon us, when supported only by fancy and imagination, how powerful must be the effect of a just and lively representation of what we know to be true and real?

How agreeable it is both to nature and reason, that a warmth of expression and vehemency of motion should rise in proportion to the importance of the subject and concern of the speaker, will further appear, by looking back a little into the more early and simple ages of the world. For the higher we go, the more we shall find of both. We shall give the observation of a very great man upon this head, in his own words. "The Romans (says he) had a very great talent this way, and the Greeks a greater. The eastern nations excelled in it, and particularly the Hebrews. Nothing can equal the strength and vivacity of the figures they employed in their discourse; and the very actions they used to express their sentiments, such as putting ashes on their heads, and tearing their garments, and covering themselves with sackcloth under any deep distress and sorrow of mind. I do not speak of what the prophets did to give a more lively representation of the things they foretold, because such figurative actions were the effect of divine inspiration. But even in other cases we find those people understood much better than we do how to express their grief, and fear, and other passions. And hence, no doubt, arose those surprising effects of eloquence, which we never experience now." Thus far this excellent writer. And what he says here with respect to the actions of the eastern nations, was in a good measure customary among the Greeks and Romans; if not entirely of the same kind, yet perhaps as vehement and expressive. They did not think language of itself sufficient to express the height of their passions, unless enforced by uncommon motions and gestures. Thus, when Achilles had driven the Trojans into their city with the greatest precipitation and terror, and only Hector ventured to tarry without the gates to engage him; Homer represents both King Priam and his queen under the highest consternation for the danger of their son. And therefore, in order to prevail with him to come into the city, and not fight with Achilles, they not only intreat him from the walls in the most tender and moving language imaginable; but he tears off his grey locks with his hands; and she, in a flood of tears, exposes her breasts, and adjures him by those paps which suckled him, to comply with their request. The poet knew very well, that no words of themselves could represent those agonies of mind he endeavoured to convey, unless heightened by the idea of such actions as were expressive of the deepest sorrow. And indeed this was anciently esteemed so requisite in an orator, that in matters of importance he was scarce thought to be in earnest who wanted it. In one of Cicero's orations, he does not stick to argue in that manner with his adversary. "Would you talk thus (says he) if you was serious? Would you, who are wont to display your eloquence so warmly in the danger of others, act so coldly in your own? Where is that concern, that ardour, which used to extort pity even from children? Here is no emotion either of mind or body: neither the forehead struck, nor the thigh, nor so much as a stamp of the foot. Therefore, you have been so far from inflaming our minds, that you have scarce kept us awake."

Dial. of Eloquence, p. 92.

As action therefore was judged so necessary a qualification in an orator among the ancients, so they made use of several methods and expedients for the better attaining it. The principal of which we shall briefly mention.

Decency of pronunciation is an habit. And as all habits are gained by time, so the sooner they are learned, they are generally acquired with greater ease. For while persons are young, they are not only more flexible, and capable of any particular bent, but they are likewise free from the trouble of encountering and subduing contrary habits, which doubles the labour, and increases the difficulty of attaining any laudable quality. Quintilian was very sensible of this in the case here before us; and therefore, in order to have persons trained up to it, he begins with them in their childhood, and descends so low as even to give directions how they should be taught to pronounce when they first learn to read. And he advises, that they should then be instructed where to suspend their voice, and make the proper pauses,

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ſes, both in diſtinguiſhing the ſeveral parts of the ſame ſentence, and in ſeparating one ſentence from another; likewiſe when to raiſe or ſink their voice, or give it a proper inflection; to be ſlower or faſter, more vehement or ſedate, as the nature of the things may require; and that the tone of their voice be always manly and grave, but at the ſame time mixed with an agreeable ſweetneſs. Theſe things may perhaps appear in themſelves ſmall; but if duly attended to, they will be found of conſiderable ſervice to bring us to a juſt and proper pronunciation. For in every thing that is to be attained by practice, it is a great advantage to ſet out right at firſt.

The ancients likewiſe had perſons whom they called *phonaſci*, whoſe proper buſineſs it was to teach them how to regulate and manage their voice; and others, who inſtructed them in the whole art of pronunciation, both as to their voice and geſtures. Theſe latter were generally taken from the theatre, being ſome eminent experienced actors. So Quintilian, treating of the province of theſe perſons, ſays, "The comedian ought to teach them how to relate facts, with what authority to adviſe, with what vehemence to expreſs anger, and with what ſoftneſs compaſſion." And ſpeaking of geſtures, he ſays, "He ſhould admoniſh them to raiſe their countenance, not diſtort their lips, or ſtretch their mouths." With ſeveral other directions of the like kind. And we are told concerning the emperor M. Antoninus, uſually called the philoſopher, that *His firſt maſters were Euphorio the grammarian, and Geminus the comedian.*

But though they made uſe of actors to inſtruct their youth in forming their ſpeech and geſtures, yet the action of an orator was much different from that of the theatre. Cicero very plainly repreſents this diſtinction in the words of Craſſus, when, ſpeaking of orators, he ſays, "The motions of the body ought to be ſuited to the expreſſions, not in a theatrical way, mimicking the words by particular geſticulations, but in a manner expreſſive of the general ſenſe, with a ſedate and manly inflection of the ſides; not taken from the ſtage and actors, but from the exerciſe of arms and the paleſtra." And Quintilian ſays to the ſame purpoſe, "Every geſture and motion of the comedians is not to be imitated, nor to the ſame degree." They thought the action of the theatre too light and extravagant for the imitation of an orator; and therefore, though they employed actors to inform young perſons in the firſt rudiments, yet they were afterwards ſent to the paleſtra, or ſchools deſigned on purpoſe, to teach them a decent and graceful management of their bodies. And ſuch ſchools, as Quintilian informs us, were in uſe both among the Greeks and Romans: Juſt as of later ages children learn to dance, in ſome meaſure with the ſame intention.

Being thus far prepared, they were afterwards ſent to the ſchools of the rhetoricians. And here, as their buſineſs was to cultivate their ſtyle, and gain the whole art of eloquence; ſo particularly to acquire a juſt and accurate pronunciation by thoſe exerciſes, in which for that end they were conſtantly employed. And as the Greeks were moſt celebrated for their ſkill in all the polite arts, and eſpecially oratory; the Roman gentry and nobility generally ſent their ſons abroad, and placed them under the tuition of ſome Grecian maſter, to inſtruct them in the art of ſpeaking, and by that means to fit them for the ſervice of their country, either in the courts of judicature or the ſenate. Thus Cicero was ſent to Rhodes, to ſtudy under the famous Molo, and Brutus under Pammenes; Cæſar was going to the ſame place when taken by pirates; and Auguſtus afterwards ſtudied there under Apollodorus.

Nor, after all this pains and induſtry, did they yet think themſelves ſufficiently qualified to take upon them the character of orators. But it was their conſtant cuſtom to get together ſome of their friends and acquaintance who were proper judges of ſuch performances, and declaim before them in private. The buſineſs of theſe perſons was to make obſervations both on their language and pronunciation. And they were allowed the greateſt freedom to take notice of any thing they thought amiſs, either as to inaccuracy of method, impropriety of ſtyle, or indecency of their voice or actions. This gave them an opportunity to correct any ſuch defects at firſt, before they became habitual. What effects might not juſtly be expected from ſuch an inſtitution! Perſons trained up in this manner, with all thoſe advantages, joined to a good natural genius, could not fail of making very complete orators. Though even after they came to appear in public, they did not lay aſide the cuſtom of declaiming. For Quintilian tells us, that *C. Carbo uſed to practiſe it daily in his tent.* And Auguſtus is reported to have continued it during the war of Mutina againſt M. Antony. Nor is it to be ſuppoſed, that ſo conſtant an attendance to this practice was only ſerviceable to them in their public performances; but it muſt neceſſarily affect their whole conduct, give them a freedom of ſpeech, eaſineſs of addreſs and behaviour, and render them in all reſpects fine gentlemen as well as excellent orators. And from hence, perhaps, we may ſee leſs reaſon to wonder at the ſurpriſing effects of ſome of their diſcourſes, when we conſider what pains they took to arrive at thoſe abilities.

Having thus far treated on pronunciation in general, we ſhall now proceed to conſider the parts of it ſeparately; which are *voice* and *geſture.*

Chap. II. *Of the Voice.*

129 Voice, a kind of ſound which always influences the paſſions, either by raiſing or allaying them.

Voice is one kind of ſounds. Now the influence of ſounds, either to raiſe or allay our paſſions, is evident from muſic. And certainly the harmony of a fine diſcourſe, well and gracefully pronounced, is as capable to move us, if not in a way ſo violent and ecſtatic, yet not leſs powerful, and more agreeable to our rational faculties. As the buſineſs of this chapter is to offer ſome conſiderations for the juſt and decent management of the voice, it may not be improper in the firſt place to obſerve in general what nature does when free and unconſtrained. As perſons are differently affected when they ſpeak; ſo they naturally alter the tone of their voice, though they do not attend to it. It riſes, ſinks, and has various inflections given it, according to the preſent ſtate and diſpoſition of the mind. When the mind is calm and ſedate, the voice is moderate and even; when the former is dejected with ſorrow, the latter is languid; and when that is inflamed by paſſion, this is raiſed and elevated. It is the orator's buſineſs, therefore, to follow nature, and to endeavour that the tone of his voice appear natural and unaffected. And for this

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this end, he must take care to suit it to the nature of the subject; but still so as to be always grave and decent. Some persons continue a discourse in such a low and drawling manner, that they can scarce be heard by their audience. Others again hurry on in so loud and boisterous a manner as if they imagined their hearers were deaf. But all the music and harmony of speech lies in the proper temperament of the voice between these extremes. In order to set this matter in a just light, it will be necessary to consider the principal affections or properties of the voice, and how they are to be regulated by an orator. Now these may all be referred either to *quantity* or *quality*.

The *quantity* of the voice consists in its *highness* or *lowness*, *swiftness* or *slowness*, and the intermediate degrees between them.

Every person who speaks in public should endeavour, if he can, to fill the place where he speaks. But still he ought to be careful not to exceed the natural key of his voice. If he does, it will neither be soft nor agreeable, but either harsh and rough, or too shrill and squeaking. Besides, he will not be able to give every syllable its full and distinct sound; which will render what he says obscure, and difficult to be understood. He should therefore take care to keep his voice within reach, so as to have it under management, that he may raise or sink it, or give it any inflection he thinks proper: which it will not be in his power to do if he put a force upon it, and strain it beyond its natural tone.

The like caution is to be used against the contrary extreme, that the voice be not dropped, and suffered to sink too low. This will give the speaker pain in raising it again to its proper pitch, and be no less offensive to the hearers. For though the music of speech consists in the variations of the voice, yet they must be gradual to render them pleasant. Such sudden and great changes at once are rather to be esteemed chasms in speaking than variations. Besides, as they often prevent the hearers from taking in the sense of what is said, it gives them no small uneasiness that they are obliged to stretch their attention. Many persons are too apt to be guilty of this, especially at the end of a sentence, by dropping the last word; which ought, in a particular manner, to be expressed distinctly, because the meaning of the whole sentence often depends upon it.

The medium between these two is a moderate and even voice. But this is not the same in all; that which is moderate in one would be high in another. Every person, therefore, must regulate it by the natural key of his own voice. A calm and sedate voice is generally best; as a moderate sound is most pleasing to the ear, if it be clear and distinct. But this equality of the voice must also be accompanied with a variety, otherwise there can be no harmony; since all harmony consists in variety. Nothing is less pleasing than a discourse pronounced throughout in one continued tone of the voice, without any change or alteration. Besides, a variation of the voice is an ease to the speaker; as the body is relieved by shifting its posture. The equality, therefore, we are here speaking of admits a variety of inflections and changes within the same pitch. And when that is altered, the gradations, whether higher or lower, should be so gentle and regular as to preserve a due proportion of the parts and harmony of the whole, which cannot be done when the voice is suddenly varied with too great a distinction. And therefore it should move from one key to another, so as rather to glide like a gentle stream, than pour down like a rapid torrent, as an ingenious writer has well expressed it: An even voice is best fitted to keep the mind to close attention. And therefore, in subjects designed only for instruction, without any address to the passions, there is little room for a variety of voice. For the voice ought to agree with the style; and as upon such subjects this should be equal, moderate, and smooth, so should the other. Every thing, as we say, is beautiful in its season; and there is a certain propriety in things which ought always to be regarded. And, therefore, an affected variety, ill-placed, is as disagreeable to a judicious audience as the want of it, where the subject requires it. We may find some persons, in pronouncing a grave and plain discourse, affect as many different tones, changes, and variations of their voice, as if they were acting a comedy; which is doubtless a very great impropriety. But the orator's province is not barely to apply to the mind, but likewise to the passions; which require a great variety of the voice, high or low, vehement or languid, according to the nature of the passions he designs to affect. So that for an orator always to use the same tone or degree of his voice, and expect to answer all his views by it, would be much the same thing as if a physician should propose to cure all distempers by one medicine. From hence it is evident, that although various inflections and tones of the voice are requisite to make it harmonious and pleasing to the ear; yet the degree of it should differ according to the nature of the subject, and design of the speaker. And, as a perfect monotony is always unpleasant, so it can never be necessary in any discourse.

The next property of the voice above-mentioned was *swiftness*. That some expressions ought to be pronounced faster and swifter than others, is very manifest. Gay and sprightly ideas should not only be expressed louder, but also faster, than such as are sad and melancholy. And when we press an adversary, the voice should be brisk and quick. But to hurry on in a precipitant manner, without pausing till stopt for want of breath, is certainly a very great fault. This destroys, not only the necessary distinction between sentence and sentence, but likewise between the several words of the same sentence; nay, and often occasions us to express our words by halves, while one is thrown so fast upon another, that we are not able to give each its full and just sound. By this means all the grace of speaking is lost, and in a great measure the advantage of hearing. For when the ears of the hearers cannot keep pace with the volubility of the speaker's tongue, they will be little the better for what he says. Besides, by not commanding his voice, and easing his breath at the proper pauses and points of distinction, he is often obliged to stop in the middle of a sentence; and so divides what should be continued, and joins what should be separated; which must necessarily destroy the sense, and confound his discourse. Young persons are very liable to this, especially at first setting out. And it often arises from diffidence. They are jealous of their performances, and the success they may have in speaking, which gives them a pain till it is over; and this puts them into a hurry of mind, which incapacitates them from governing their voice, and keeping it under that due

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due regulation which perhaps they proposed to themselves before they began to speak. And the greater degree such persons have of a native and ingenuous modesty, accompanied with a laudable ambition to excel, they are commonly more exposed to this. For while, on the one hand, they are fired with an ardent desire to recommend themselves, and on the other are fearful of the event, this dubious state of mind is very apt to throw them off their guard, and run them into this excess. From which we may see the great advantage of having the voice well formed betimes; for when once it is become habitual to speak with justness and propriety, persons readily practise it without much attention or concern.

And as a precipitant and hasty pronunciation is culpable, so likewise, on the other hand, it is a fault to speak too slow. This seems to argue a heaviness in the speaker. And as he appears cool himself, he can never expect to warm his hearers, and excite their affections. When not only every word, but every syllable is drawn out to too great a length, the ideas do not come fast enough to keep up the attention without much uneasiness. For till the sense is completed, the mind is in suspense; and, if it be held long in that situation, it will of course flag and grow tired. Indeed, in some cases, it is requisite the pronunciation should be slower than in others; as in representing things great and difficult; or in expressing some particular passions, as admiration or grief. But the extreme we are now speaking of, is a slowness equally continuing through a whole discourse, which must necessarily render it flat and lifeless.

Now, to avoid either of the two extremes last mentioned, the voice ought to be sedate and distinct. And in order to render it distinct, it is necessary, not only that each word and syllable should have its just and full sound, both as to time and accent; but likewise that every sentence, and part of a sentence, should be separated by its proper pause and interval. This is more easy to be done in reading, from the assistance of the points; but it is no less to be attended to in speaking, if we would pronounce in a distinct and graceful manner. For every one should speak in the same manner as he ought to read, if he could arrive at that exactness. Now the common rule given in pausing is, that we stop our voice at a comma till we can tell one, at a semicolon two, at a colon three, and at a full period four. And as these points are either accommodated to the several parts of the same sentence, as the first three; or different sentences, as the last; this occasions the different length of the pause, by which either the dependence of what precedes upon that which follows, or its distinction from it, is represented. And, therefore, in the first three stops, the voice is rather to be suspended in different degrees or measures of time than entirely dropt, to show that the sense is not yet completed. But between sentence and sentence we respire, and begin anew. So that in long periods the voice should be favoured by beginning low and sedately, that it may hold to the end without respiration; or if it will not, the breath ought to be recovered without sinking the voice. For if once the voice drop for want of breath before the period be finished, not only the beauty, but likewise the sense of it, will be lost. Quintilian lays a great stress upon a due attention to these pauses; and says, "Though it may appear not so considerable in itself, yet all the other virtues of a good pronunciation are deficient without it."

Hitherto we have considered such properties of the voice as respect *quantity*, we come now to speak of its *qualities*. And the chief of these are *strength* or *weakness*, *clearness* or *obscureness*, *fulness* or *smallness*, *smoothness* or *roughness*. Now, one half of these is what every one would willingly choose, as he would wish to be free from the others. But it is not in our power to give ourselves what qualities of the voice we please; but only to make the best use we can of what nature has bestowed upon us. However, several defects of the voice are capable of being helped by care and proper means; as, on the other hand the best voice may be greatly hurt by ill management and indiscretion. Temperance is a great preservative of the voice, and all excess is highly prejudicial to it. The voice must necessarily suffer, if the organs of speech have not their proper tone. And in order to their having this, they must be kept in a due temperature; that is, they must neither be too moist nor too dry. If they abound with fluids, these will obstruct the clearness of the voice, and render it obscure and confused; and if they are parched with drought, the voice will be harsh and rough. Now all excesses, as well as some bodily indispositions, are apt to affect the organs one or other of these ways.

A strong voice is very serviceable to an orator, because if it want some other advantages, he is, however, capable to make himself heard. And if at any time he is forced to strain it, he is in less danger of its failing him before he has finished his discourse. But he who has a weak voice, should be very careful not to strain it, especially at first. He ought to begin low, and rise gradually to such a pitch as the key of his voice will well carry him, without being obliged to sink again afterwards. Frequent inflections of the voice will likewise be some assistance to him. But especially he should take care to speak deliberately, and ease his voice, by allowing due time for respiration at all the proper pauses. It is an extreme much less inconvenient for such a person rather to speak too slow, than too fast. But this defect of a weak voice is sometimes capable of being helped by the use of proper methods; as is evident from the instance of Demosthenes, before-mentioned.

A voice is said to be *clear*, when the organs of speech are suited to give every single letter, and all the combinations of them in syllables and words, their proper and distinct sound. Such a voice is very pleasing and agreeable to the hearers: and no less an happiness to the speaker, as it saves him a great expence of spirits. For a moderate voice, if clear, will be as distinctly heard, as one much louder, if thick and obscure. Which is a great advantage to the speaker, because he can better keep his voice under command, and modulate it at pleasure, as the several parts and circumstances of his discourse may require. On the contrary, an obscure and confused voice is not always occasioned from a deficiency in the organ; but many times is the effect of custom and a bad habit. Some persons, either from want of due care in their education at first, or from inadvertency and negligence afterwards, run into a very irregular and confused manner of expressing their words; either by misplacing the accent, confounding the sound of the letters, Pronunciation. letters, or huddling the syllables one upon another, so as to render what they say often unintelligible. Indeed, sometimes this arises from a natural defect, as in the case of Demosthenes; who found a method to rectify that, as well as the weakness of his voice. But in faults of this kind, which proceed from habit, doubtless the most likely way to mend them is to speak deliberately.

A full voice is not the same as a strong or a loud voice. It fills the ear, but it is often not pleasant. And therefore to render it so, as well as audible, it should be frequently varied. However, this seems better suited to the character of an orator, than a small and shrill voice; because it has something in it more grave and manly. And those who have the misfortune of a very small voice, should be cautious of raising it to too high a pitch, especially at once; because the sudden compressure of the organ is apt to occasion a squeaking and very disagreeable sound.

A soft and smooth voice is of all the most musical, especially if it be flexible. And, on the contrary, nothing is less harmonious than a voice that is harsh and rough. For the one grates as disagreeably upon the ear, as the other gives it pleasure and delight.

From the consideration of these several properties of the voice, we may conclude that to be the best, and fittest for an orator, which is moderate, distinct, firm, clear, and smooth, and withal easily flexible to the several degrees and variations of sound which every part of the discourse may require.

Chap. III. *Of Gesture.*

130 Gesture is the conformity of the motions of the countenance, &c. to the nature of the discourse.

By this is meant, a suitable conformity of the motions of the countenance, and several parts of the body, in speaking, to the subject-matter of the discourse. The word *gesture* is here used in a larger sense than is ordinarily done in common language. For we rarely make use of that word to denote the motions of the countenance, or any parts of it; but as these make a considerable part of our present subject, they must here be comprehended under this term.

It is not agreed among the learned, whether voice or gesture has the greater influence upon us. But as the latter affects us by the eye, as the former does by the ear, gesture in the nature of it seems to have this advantage, that it conveys the impression more speedily to the mind; for the sight is the quickest of all our senses. Nor is its influence less upon our passions; nay, in some instances it appears to act more powerfully. A cast of the eye shall express desire in as moving a manner as the softest language; and a different motion of it, resentment. To wring the hands, tear the hair, or strike the breast, are all strong indications of sorrow. And he who claps his hand to his sword, throws us into a greater panic than one who only threatens to kill us. Nor is it in some respects less various and extensive than language. Cicero tells us, he often diverted himself by trying this with Roscius the comedian; who could express a sentence as many ways by his gestures, as he himself by words. And some dramas, called *pantomimes*, have been carried on wholly by mutes, who have performed every part by gestures only, without words, in a way very intelligent, as well as entertaining to the spectators. Well, therefore, might Cicero call *action* (or gesture) *the language of the body*, since it is capable in so lively a manner to convey both our ideas and passions. But with respect to oratory, gesture may very properly be called the *second part of pronunciation*; in which, as the voice should be suited to the impressions it receives from the mind, so the several motions of the body ought to be accommodated to the various tones and inflections of the voice. When the voice is even and moderate, little gesture is required; and nothing is more unnatural than violent motion, in discoursing upon ordinary and familiar subjects. The motions of the body should rise therefore in proportion to the vehemence and energy of the expression, as the natural and genuine effect of it.

But as gesture is very different and various as to the manner of it, which depends upon the decent conduct of several parts of the body; it will not be amiss to consider more particularly the proper management of each of those parts. Now all gesture is either natural, or from imitation. By natural gesture we mean such actions and motions of the body, as naturally accompany our words, as these do the impressions of our minds. And these either respect the whole body, or some particular part of it. But before we enter upon this, give us leave just to observe, that it has been customary in all ages and countries, in making a set discourse before an assembly, to do it standing. Thus we read, that *Abraham stood up, and spake unto the children of Heth.* And it seems as if he sat down when he had ended his speech; because, immediately after the account of their answer, it is said again, that *Abraham stood up and bowed himself to the people of the land, the children of Heth.* In like manner Homer represents the Grecian princes, as standing up, when they made a speech, either to the army, or in their councils. So when Achilles has assembled the army, to inquire into the reason of the great plague which at that time raged among them, he rises up before he begins to speak, and sits down again when he has done. After him the prophet Calchas rises, and charges it upon Agamemnon; who rising up in a passion, does not refuse to comply with what Calchas proposed, but expresses his resentment at him for saying it. And upon another occasion both Agamemnon and Nestor do the same in council. And Cicero acquaints us, that when Lentulus had been charged in the senate as an associate with Catiline, he stood up to make his defence. Nor does the advantage of being better heard, seem to have been the only reason for so general an agreement in this posture; but it appears likewise to have been chosen, as the most decent and respectful. Sitting carries in it an air of authority, and is therefore a posture scarce used upon such occasions, unless perhaps where that is designed to be expressed by it. Wherefore it was a thing very much resented, that when Cæsar after he had got the power into his hands, once addressed the senate, either refused to rise, as some say, or as others, one of his friends held him down by his gown.

But though standing appears to be the most proper posture for speaking in public, yet it is very unbecoming for the body to be entirely without any motion like a statue. It should not long continue in the same position, but be constantly changing, though the motion be very moderate. There ought to be no appearance of stiffness, but a certain ease and pliableness, naturally suiting itself to every expression; by which

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which means, when a greater degree of motion is neceſſary, it will appear leſs ſudden and vehement: For as the raiſing, ſinking, and various inflections of the voice muſt be gradual; ſo likewiſe ſhould the motions of the body. It is only on ſome particular occaſions that an haſty vehemence and impetuoſity is proper in either caſe.

As to the ſeveral parts of the body, the head is the moſt conſiderable. To lift it up too high has the air of arrogance and pride; to ſtretch it out too far, or throw it back, looks clowniſh and unmannerly; to hang it downwards on the breaſt, ſhows an unmanly baſhfulneſs and want of ſpirit; and to ſuffer it to lean on either ſhoulder, argues both ſloth and indolence. Wherefore in calm and ſedate diſcourſe it ought to keep its natural ſtate, an upright poſture. However, it ſhould not be long without motion, nor yet always moving; but gently turn ſometimes on one ſide, and ſometimes on the other, as occaſion requires, that the voice may be heard by all who are preſent; and then return again to its natural poſition. It ſhould always accompany the other actions of the body, and turn on the ſame ſide with them; except when averſion to any thing is expreſſed, which is done by ſtretching out the right hand, and turning the head to the left. The ancients erected a ſtatue of Venus in this poſture, who was called by the Greeks *αποςροφια*, and by the Latins *Verticordia*, and in Engliſh may be termed the *forbidding Venus*. But nothing is more indecent than violent motions and agitations of the head. And therefore when a witty writer, who is well known among us, would convey the moſt ridiculous idea of a pretender to knowledge, he expreſſes it thus:

> For having three times ſhook his head
> To ſtir his wit up, thus he ſaid. HUDIBRAS.

But it is the countenance that chiefly repreſents both the paſſions and diſpoſition of the mind. By this we expreſs love, hatred, joy, ſorrow, modeſty, and confidence: by this we ſupplicate, threaten, ſoothe, invite, forbid, conſent, or refuſe; and all this without ſpeaking. Nay, from hence we form a judgement not only of a perſon's preſent temper, but of his capacity and natural diſpoſition. And therefore it is common to ſay, *ſuch an one has a promiſing countenance*, or *that he promiſes little by his countenance*. It is true, this is no certain rule of judging; nor is it in the power of any one to alter the natural make of his countenance: however, it may put us upon endeavouring to gain the moſt pleaſing aſpect we can; ſince it is ſo natural for mankind to draw ſuch concluſions from it: and ſome perſons are ſo unhappy, as to render their countenance more diſagreeable, than otherwiſe it would be, by ill habits.

But the ſeveral parts of the face bear their part, and contribute to the proper and decent motion of the whole. In a calm and ſedate diſcourſe, all the features retain their natural ſtate and ſituation. In ſorrow, the forehead and eyebrows lower, and the cheeks hang down. But in expreſſions of joy and cheerfulneſs, the forehead and eyebrows are expanded, the cheeks contracted, and the corners of the mouth drawn upwards. Anger and reſentment contract the forehead, draw the brows together, and thruſt out the lips. And terror elevates both the brows and forehead. As theſe are the natural ſigns of ſuch paſſions, the orator ſhould endeavour to conform to them.

But as the eyes are moſt active and ſignificant, it is the advice of Cicero that the greateſt care ſhould be taken in their management. And he gives this reaſon for it, "Becauſe other parts of the countenance have but few motions; whereas all the paſſions of the ſoul are expreſſed in the eyes, by ſo many different actions, which cannot poſſibly be repreſented by any geſtures of the body, if the eyes are kept in a fixed poſture." Common experience does in a great meaſure confirm the truth of this obſervation. We readily gueſs at a perſon's intention, or how he is affected to us, by his eyes. And any ſudden change or emotion of the mind is preſently followed by an alteration in the look. In ſpeaking therefore upon pleaſant and delightful ſubjects, the eyes are briſk and cheerful; as on the contrary, they ſink and are languid in delivering any thing melancholy and ſorrowful. This is ſo agreeable to nature, that before a perſon ſpeaks, we are prepared with the expectation of one or the other from his different aſpect. So likewiſe in anger, a certain vehemence and intenſeneſs appears in the eyes, which, for want of proper words to expreſs it by, we endeavour to repreſent by metaphors taken from fire, the moſt violent and rapid element, and ſay, in ſuch caſes, the *eyes ſparkle*, *burn*, or are *inflamed*. In expreſſions of hatred or deteſtation, it is natural to alter the look, either by turning the eyes aſide, or downwards. Virgil has very juſtly obſerved this: for when he deſcribes Æneas meeting with Dido in the Elyſian ſhades, and addreſſing her, he repreſents her diſregard of him, by ſaying,

> Diſdainfully ſhe look'd; then turning round,
> Still fix'd her eyes unmov'd upon the ground.

She ſhowed her reſentment for his former treatment of her, by not vouchſafing to look on him. Indeed, the eyes are ſometimes turned downwards upon other occaſions, as to expreſs modeſty. And if at any time a particular object be addreſſed to, whatever it be, the eyes ſhould be turned that way. And therefore Philoſtratus very deſervedly ridicules a certain rhetorician as guilty of a ſoleciſm in geſture, who, upon ſaying, *O Jupiter!* turned his eyes downward; and when he ſaid, *O earth!* looked upward. A ſtaring look has the appearance of giddineſs and want of thought; and to contract the eyes, gives ſuſpicion of craft and deſign. A fixed look may be occaſioned from intenſeneſs of thought, but at the ſame time ſhows a diſregard to the audience; and a too quick and wandering motion of the eyes denotes levity and wantonneſs. A gentle and moderate motion of the eyes is therefore in common moſt ſuitable, always directed to ſome of the audience, and gradually turning from ſide to ſide with an air of reſpect and modeſty, and looking them decently in the face, as in common diſcourſe: Such a behaviour will of courſe draw an attention. As in converſation, when a perſon addreſſes us in an handſome and becoming manner, we preſently put ourſelves in a poſture to give what he ſays a proper reception. But as all the paſſions are in the moſt lively manner expreſſed in the eyes, their motions ought to vary according to the different nature of thoſe paſſions they are ſuited both to diſcover in the ſpeaker, and convey to his hearers; ſince, as the quickeſt acceſs to the mind is by the ſight, a proper well-timed look will

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As to the other parts of the body diſtinct from the head, the ſhoulders ought not to be elevated; for this is not only in itſelf indecent, but it likewiſe contracts the neck, and hinders the proper motion of the head. Nor, on the other hand, ſhould they be drawn down, and depreſſed; becauſe this occaſions a ſtiffneſs both to the neck and the whole body. Their natural poſture therefore is beſt, as being moſt eaſy and graceful. To ſhrug the ſhoulders has an abject and ſervile air; and frequently to heave them upwards and downwards is a very diſagreeable ſight.

A continued motion of the arms any way, is by all means to be avoided. Their action ſhould generally be very moderate, and follow that of the hands, unleſs in very pathetic expreſſions, where it may be proper to give them a more lively ſpring.

The hands need never be idle. Quintilian ſeems to think them as neceſſary and powerful in action, as Cicero does the eyes. "The hands (ſays he), without which all geſture is lame and weak, have a greater variety of motions than can well be expreſſed; for they are almoſt equal to our words. Do not we deſire with them, promiſe, call, diſmiſs, threaten, beſeech, deteſt, fear, inquire, deny? Do not they expreſs joy, ſorrow, doubt, confeſſion, penitence, meaſure, plenty, number, and time? Do not they excite, reſtrain, prove, admire, and ſhame? that in ſo great a variety of ſpeech among all nations and countries, this ſeems to me the common language of all mankind." Thus far Quintilian. Now, all bodily motion is either upward or downward, to the right or left, forward or backward, or elſe circular. The hands are employed by the orator in all theſe, except the laſt. And as they ought to correſpond with our expreſſions, ſo they ought to begin and end with them. In admiration, and addreſſes to heaven, they muſt be elevated, but never raiſed above the eyes; and in ſpeaking of things below us, they are directed downwards. Side motion ſhould generally begin from the left, and terminate gently on the right. In demonſtrating, addreſſing, and on ſeveral other occaſions, they are moved forward; and in threatening, ſometimes thrown back. But when the orator ſpeaks of himſelf, his right-hand ſhould be gently laid on his breaſt. When no other motion is neceſſary, the hands ſhould be kept about as high as the breaſt, ſo as to make near a right angle with the arm. This is not only graceful, but likewiſe the moſt eaſy poſture, and gives the leaſt ſtrain to the muſcles. They ſhould never be ſuffered to hang down, nor to loll upon the cuſhion or bar. The left hand ſhould never move alone, but accommodate itſelf to the motions of the right. In motions to the left ſide, the right hand ſhould not be carried beyond the left ſhoulder. In promiſes and expreſſions of compliment, the motion of the hands ſhould be gentle and ſlow; but in exhortations and applauſe more ſwift. The hands ſhould generally be open; but in expreſſions of compunction and anger they may be cloſed. All finical and trifling actions of the fingers ought to be avoided; nor ſhould they be ſtretched out and expanded in a ſtiff and rigid poſture, but kept eaſy and pliable.

Neither the breaſt nor the belly ſhould be thruſt out; which in itſelf looks ungainly, and hinders the free motion of the trunk; which ought not to be kept too ſtiff and upright, but eaſy and flexible, always ſuiting itſelf to the motions of the head and hands. The feet ſhould continue ſteady, and not give the body a wavering and giddy motion by frequently ſhifting; though ſome perſons fall into that habit without moving their feet. Curio, a Roman orator, as Cicero tells us, was addicted to this; which occaſioned a friend of his once to paſs a joke upon him, by aſking, *Who that was talking out of a boat?* The jeſt is too plain to need explication; for every one knows the waving of a boat will give the body ſuch a motion.

The geſtures we have hitherto diſcourſed of, are ſuch as naturally accompany our expreſſions. And we believe thoſe we have mentioned, if duly attended to, will be found ſufficient to anſwer all the purpoſes of our modern pronunciation. The ancients, indeed, uſed ſeveral more vehement actions and geſtures than we are accuſtomed to; as we have formerly ſhown. Philip the Roman orator, as Cicero informs us, did not uſe to prepare his diſcourſes; but ſpoke, as we ſay, *off-hand.* And he was wont to tell his friends, "he was never fit to talk till he had warmed his arm." He doubtleſs, therefore, uſed a more violent motion with his arms and hands than is common with us. And Cicero calls the arm projected *the orator's weapon.* Indeed, to extend or brandiſh the arm, carries in it an air of command and authority, which was not unbecoming the character of Philip, who was a perſon of the higheſt rank and quality. And therefore young orators, both among the Greeks and Romans, for a time uſed no motion of the arm, but kept it confined in their garment, as an argument of modeſty, till age and experience allowed them to uſe greater freedom. Nor was it uncommon for the ancient orators to expreſs the exceſs of their paſſions by tears. They thought nothing unbecoming that was natural: and judged it agreeable to the characters even of the braveſt men, to be touched with a ſenſe of humanity in great calamities: And therefore we find both Homer and Virgil make their greateſt heroes ſhed tears on ſome occaſions.

The other ſort of geſtures above-mentioned are ſuch as ariſe from imitation; as where the orator deſcribes ſome action, or perſonates another ſpeaking. But here great care is to be taken not to over-act his part, by running into any ludicrous or theatrical mimicry. It is ſufficient for him ſo to repreſent things of this nature, as may beſt convey the image of them in a lively manner to the minds of the hearers; without any ſuch change either of his actions or voice as are not ſuitable to his own character.

CHAP. IV. *Some particular Rules for the Voice and Geſture.*

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THE ſubject of pronunciation is of ſo great importance to an orator, that it can neither be too clearly laid down, nor too ſtrongly inculcated. If we inquire into the cauſes of that ſurpriſing power it has over us, and by what means it ſo ſtrongly affects us, this may in ſome meaſure appear by reflecting on the frame and conſtitution of human nature. For our infinitely wiſe and great Maker has ſo formed us, that not only the actions of the body are ſubject to the direction of the mind, but we are likewiſe endowed with various

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passions and affections, that excite us to pursue those things which make for our happiness, and avoid others which are hurtful to us. And as we are made for society, we are also furnished with speech, which enables us to converse with one another. And such is the contrivance of our make, and influence of our minds upon the mechanism of our bodies, that we can not only communicate our thoughts to each other, but likewise our passions. For, as Cicero well observes, "Every motion of the mind has naturally its peculiar countenance, voice, and gesture; and the whole body, every position of the face, and sound of the voice, like the strings of an instrument, act agreeably to the impression they receive from the mind." Nor is this all: but as every one is differently affected himself, he is capable to make the like impressions upon others, and excite them to the same motions which he feels in himself. As when two instruments are set to the same pitch, the strings of the one being touched, produce in the other the like sound. This common sympathy in the human frame shows how necessary it is that an orator should not only in general be well acquainted with the rules of pronunciation, but likewise know how to use them as occasion requires; for a general knowledge of the rules of art is not of itself sufficient to perfect an artist, without a further acquaintance with the particular application of them to their several cases and circumstances. Thus, for instance, it is not enough for an orator to understand all the beauties and ornaments of language, and which of them are suited to form the several kinds of style, unless he can likewise accommodate each of those characters to their proper subject. And so likewise in pronunciation, he ought not only to know the several qualities of the voice, and proper gestures of the body, but also when and where to make use of them. For not only different subjects, but also different parts of the same discourse, and even particular expressions, often require a difference in the manner of pronunciation, both as to the voice and gesture. Having therefore treated on both these parts of pronunciation in general, it may not be amiss now to consider how they are to be applied in each of the two respects last mentioned.

We shall begin with the parts of a discourse, and treat of them in their natural order. And here the view and design of the speaker in each of them will easily help us to see the proper manner of pronunciation.

Let us suppose then a person presenting himself before an assembly, in order to make a discourse to them. It cannot be decent immediately to begin to speak so soon as ever he makes his appearance. He will first settle himself, compose his countenance, and take a respectful view of his audience. This prepares them for silence and attention. To begin presently, and hurry on, without first allowing either himself or his hearers time to compose themselves, looks as if he was rather performing a task than had any design to please them; which will be very apt to make them as uneasy till he has done, as he seems to be himself. Persons commonly form some opinion of a speaker from their first view of him, which prejudices them either in his favour, or otherwise, as to what he says afterwards. A grave and sedate aspect inclines them to think him serious; that he has considered his subject, and may have something to offer worth their attention. A haughty and forbidding air occasions distaste, as it looks like disrespect. A wandering giddy countenance argues levity. A dejected drooping appearance is apt to raise contempt, unless where the subject is melancholy. And a cheerful aspect is a proper prelude to a pleasant and agreeable argument.

To speak low at first has the appearance of modesty, and is best for the voice; which, by rising gradually, will with more ease be carried to any pitch that may be afterwards necessary, without straining it. However, some variation of the voice is always proper to give it an harmony. Nay, and sometimes it is not improper for an orator to set out with a considerable degree of warmth, expressed by such an elevation of the voice, and gestures of the body, as are suited to represent the emotions of his mind. But this is not ordinarily the case. We have some few instances of this in Cicero; as in his oration for Roscius Amerinus, where the heinousness of the charge could not but excite his indignation against the accusers. And so likewise in that against Piso, and the two first against Catiline, which begin in the same manner, from the resentment he had conceived against their persons and conduct.

In the narration, the voice ought to be raised to somewhat an higher pitch. Matters of fact should be related in a very plain and distinct manner, with a proper stress and emphasis laid upon each circumstance, accompanied with a suitable address and motions of the body, to engage the attention of the hearers. For there is a certain grace in telling a story, by which those who are masters of it seldom fail to recommend themselves in conversation. The beauty of it consists in an easy and familiar manner of expression, attended with such actions and gestures as are suited to the nature of the things related, and help to enliven each particular circumstance and part of the discourse.

The proposition, or subject of the discourse, should be delivered with a very clear and audible voice. For if this be not plainly heard, all that follows in proof of it cannot well be understood. And for the same reason, if it be divided into several parts or branches, they should each be expressed very deliberately and distinctly. But as the design here is only information, there can be little room for gesture.

The confirmation admits of great variety both of the voice and gestures. In reasoning, the voice is quick and pungent, and should be enforced with suitable actions. And as descriptions likewise have often a place here, in painting out the images of things, the orator should so endeavour to adapt both his voice, and the motions of his body, particularly the turn of his eyes, and action of his hands, as may best help the imagination of his hearers. Where he introduces another person speaking, or addresses to an absent person, it should be with some degree of imitation. And in dialogue the voice should alter with the parts. When he diverts from his subject by any digression, his voice should be lively and cheerful; since that is rather designed for entertainment than instruction.

In confutation, the arguments of the adverse party ought first to be repeated in a plain and distinct manner, that the speaker may not seem to conceal, or avoid the force of them, unless they appear trifling

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and unworthy of a serious answer; and then a facetious manner, both of expression and gesture, may be the properest way to confute them. For to attempt to answer in a grave and serious manner, what is in itself empty and ludicrous, is apt to create a suspicion of its having more in it than it really has. So when Tubero, in his accusation of Ligarius before Cæsar, had made it part of his charge, that Ligarius was in Africa during some part of the civil war between Cæsar and Pompey; Cicero, in his answer, not thinking it deserved a serious reply, contents himself with barely mentioning it ironically. For thus he begins his defence of Ligarius: "Cæsar, my kinsman Tubero has laid before you a new crime, and till this day unheard of, that Q. Ligarius was in Africa." Every one must easily perceive, by the manner in which these words were pronounced, that the design of them was to make the charge appear ridiculous. But caution should be used not to represent any argument of weight in a ludicrous way, lest by so doing the speaker should more expose himself than his adversary.

In the conclusion, both the voice and gesture should be brisk and sprightly, which may seem to arise from a sense of the speaker's opinion of the goodness of his cause, and that he has offered nothing but what is agreeable to reason and truth; as likewise from his assurance that the audience agree with him in the same sentiments. In every undertaking that requires care and thought, persons are apt at first to be sedate and moderate; but when it is drawing to an end, and is near finished, it is very natural to appear more gay. If an enumeration of the principal arguments of the discourse be convenient, as it sometimes is, where they are pretty numerous, or the discourse is long, they ought to be expressed in the most clear and forcible manner. And if there be an address to the passions, both the voice and gesture must be suited to the nature of them, of which more will be said presently.

We proceed now to the consideration of particular expressions. And what we shall offer here, will be first in relation to single words, then sentences, and lastly the passions.

132 I. Even in those sentences which are expressed in the most even and sedate manner, there is often one or more words which require an emphasis and distinction of the voice. Pronouns are often of this kind; as, *This is the man.* And such are many words that denote the circumstances and qualities of things. Such as heighten or magnify the idea of the thing to which they are joined, elevate the voice; as *noble*, *admirable*, *majestic*, *greatly*, and the like. On the contrary, those which lessen the idea, or debase it, depress the voice, or at least protract the tone; of which sort are the words *little*, *mean*, *poorly*, *contemptible*, with many others. Some tropes likewise, as metaphors and verbal figures, which consist in the repetition of a single word, should have a particular emphasis. As when Virgil says of the river Araxes, *It disdained a bridge.* And Nisus of himself in the same poet, *I, I am the man;* where the repeated word is loudest. This distinction of words, and giving them their proper emphasis, does not only render the expression more clear and intelligible, but very much contributes to the variation of the voice, and the preventing a monotony. And the different pronunciation of these words will also require a peculiar gesture.

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II. In sentences, regard should be had to their length, and the number of their parts, in order to distinguish them by proper pauses. The frame and structure of the period ought likewise to be considered, that the voice may be so managed as to give it the most musical accent. Unless there be some special reason for the contrary, it should end louder than it begins. And this difference of tone between the end of the former sentence and the beginning of the next, not only helps to distinguish the sense, but adds to the harmony of the voice. And that the last syllables of a sentence might become more audible and distinct, was doubtless one reason why the ancient rhetoricians dislike short feet at the end of a period. In an antithesis, or a sentence consisting of opposite parts, one contrary must be louder than the other. As, "*He is gone, but by a gainful remove, from* painful labour to quiet rest; *from* unquiet desires *to happy* contentment; *from* sorrow *to* joy; *and from* transitory time *to* immortality." In a climax or gradation, the voice should rise with it. So, "*There is no enjoyment of* property *without* government; *no* government *without a* magistrate; *no* magistrate *without* obedience; *no* obedience *where every one acts as he* pleases." And so in other gradations of a different form. As, "*Since* concord *was lost*, friendship *was lost*, fidelity *was lost*, liberty *was lost*, all *was lost*." And again, "*You would pardon him whom the* senate *hath condemned*, *whom* the people of Rome *have condemned*, *whom* all mankind *have condemned*." We might mention several other figurative expressions, which require a particular conformation and management of the voice; but these, we presume, with some others we shall have occasion to name presently when we come to the passions, may be sufficient to guide us in the rest. But that it may appear more evidently how necessary a different inflection and variation of the voice is in most sentences, give us leave to show how Quintilian illustrates it, by a passage which he takes from Cicero. The place is the beginning of Cicero's defence for Milo, and the words are these: "*Although I am apprehensive it may seem base to discover fear when I enter upon the defence of* a most courageous man, *and it may appear very indecent*, when Milo discovers more concern for the public safety than for his own, *not to show a greatness of mind equal to his cause, yet this new form of the court terrifies my eyes*, which cannot discern the ancient manner of the forum, and former custom of trials, *whatever way they look:* your bench is not surrounded with its usual attendents." This sentence consists of four members. And Quintilian supposes, that though these words are the beginning of a speech, and were accordingly expressed in a calm and submissive manner, yet that the orator used a great deal of variety in the pronunciation of their several parts. In the first member (as he imagines) his voice was more elevated in expressing the words, *a most courageous man*, than in those other parts of it *I am apprehensive it may seem base*, and, *to discover fear.* In the second member he rose higher, in saying, *when Milo discovers more concern for the public safety than for his own*; and then again, as it were, checked himself in what follows, *not to show a greatness of mind* 133

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134 III. That the passions have each of them both a different voice and action, is evident from hence; that we know in what manner a person is affected, by the tone of his voice, though we do not understand the sense of what he says, or many times so much as see him: and we can often make the same judgement from his countenance and gestures. Love and esteem are expressed in a smooth and cheerful tone: but anger and resentment, with a rough, harsh, and interrupted voice; for when the spirits are disturbed and ruffled, the organs are moved unequally. Joy raises and dilates the voice, as sorrow sinks and contracts it. Cicero takes notice of a passage in an oration of Gracchus, wherein he bewails the death of his brother, who was killed by Scipio, which in his time was thought very moving: "*Unhappy man* (says he), *whither shall I betake myself? where shall I go?* Into the capitol? *that flows with my brother's blood.* Shall I go home; *and behold my unhappy mother all in tears and despair?*" Though Gracchus had a very ill design in that speech, and his view was to excite the populace against their governors, yet (as Cicero tells us) when he came to this passage, he expressed himself in such moving accents and gestures, that he extorted tears even from his enemies. Fear occasions a tremor and hesitation of the voice, and assurance gives it strength and firmness. Admiration elevates the voice, and should be expressed with pomp and magnificence: *O surprising clemency, worthy of the highest praise and greatest encomiums, and fit to be perpetuated in lasting monuments!* This is Cicero's compliment to Cæsar when he thought it for his purpose. And oftentimes this passion is accompanied with an elevation both of the eyes and hands. On the contrary, contempt sinks and protracts the voice. In the dispute between Cicero and Cecilius, which of them should accuse Verres, Cicero puts this contemptuous question to him: "How are you qualified, Cecilius, for such an undertaking? I will not ask, when you ever gave a proof of it; but when you so much as attempted it? Do you consider the difficulty of managing a public cause?" with much more to the same purpose. Though such kind of expressions require little gesture, yet sometimes a motion of the hand may not be improper, to signify disdain or aversion. We may suppose Cicero to have acted thus in his defence of Rabirius. For to show his assurance of his client's cause, having used this expression in a very audible manner, "I wish I had it to say, that Rabirius had with his own hand killed Saturninus, who was an enemy to the Roman state," some persons in the crowd began to raise a clamour, just as of later times hissing has been practised on the like occasions. Upon which Cicero immediately replies, "This noise does not disturb me, but please me, since it shows, though there are some weak persons, yet they are but few." Then presently after follows the expression we refer to: "Why do not you cease your clamour, since it only discovers your folly, and the smallness of your number?" All exclamations should be violent. When we address to inanimate things, the voice should be higher than when to animated beings; and appeals to heaven must be made in a loftier tone than those to men.

These few hints for expressing the principal passions may, if duly attended to, suffice to direct our practice in others. Though, after all, it is impossible to gain a just and decent pronunciation of voice and gesture merely from rules without practice and an imitation of the best examples. Which shows the wisdom of the ancients, in training up their youth to it, by the assistance of masters, to form both their speech and actions.

But there is one thing which ought always to be attended to; namely, that persons should well consider their own make and genius, especially with respect to the passions. We seldom find, that any actor can excel in all characters; but if he performs one well, he is deficient in another: And therefore they are commonly so prudent as to confine themselves to such as best suit them. The case is the same in an orator; who should therefore keep within those bounds which nature seems to have prescribed for him. Some are better fitted for action than others, and most for some particular actions rather than others; and what fits well upon one would appear very awkward in another. Every one, therefore, should first endeavour to know himself, and manage accordingly. Though in most cases, nature may be much assisted and improved by art and exercise. See Professor Ward's *System of Oratory*.

Oratory, Orb. ORATORY, among the Romanists, a closet or like apartment near a bed-chamber, furnished with an altar, crucifix, &c. for private devotions.

ORB, in *Astronomy*, denotes a hollow globe or sphere.

ORB, in tactics, is the disposing of a number of soldiers in circular form of defence. The orb has been thought of consequence enough to employ the attention of the famous Marshal de Puysegur in his Art of War, who prefers this position to throw a body of infantry in an open country, to resist cavalry, or even a superior force of infantry; because it is regular, and equally strong,